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COMPUTING FOR HOME AND BUSINESS APPLICATIONS

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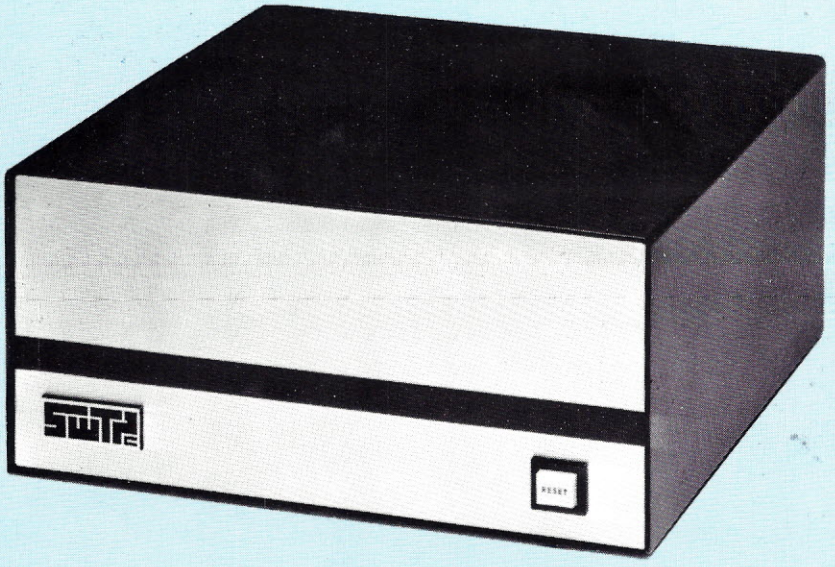
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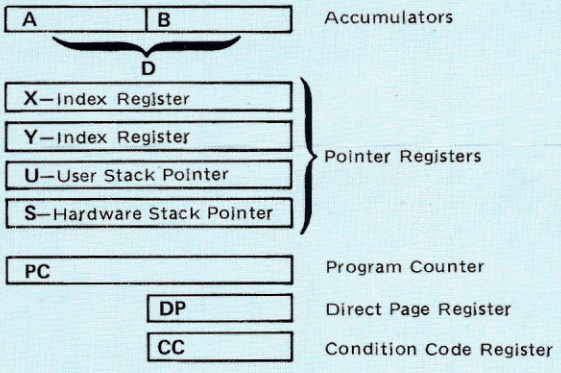


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VOL. 4, ISSUE 4
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APRIL 1979

# INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS


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Designed by Fino Ortiz, photography by Don May. The robot is Ultima Futura Automaton.

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# HOW TO STAY ON TOP

## Controlling Your World

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When we designed the DB8/2, we knew that it had to be a dependable performer in handling large quantities of information. So, every design decision was made with quality and dependability in mind. The DB8/2 is a first-class producer.

For example, it uses two quad density 5.25-inch disk drives with our exclusive Dual Density Disk Controller for up to 1.2 megabytes of formatted storage. That gives you more capacity than two single-density 8-inch drives which means a lower cost per kilobyte. The DYNABYTE DB8/2 is the first microcomputer to offer enough storage capacity on 5.25-inch disk drives to fully utilize CP/M,* the most widely accepted disk operating system.

We also supply and support BASIC, FORTRAN and COBOL programming languages. As for applications packages include general ledger, accounts receivable, accounts payable, word processing and many other CP/M compatible programs.

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**For more information, call Rick Mehrlich at (415) 965-1010, or see your local computer dealer.**

*CP/M is a trademark of Digital Research

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DYNABYTE

# EDITOR'S NOTEBOOK

## THINKING BACK

Just the other day I was musing over what it must have been like some 100 years ago. No TV, no radio and no one had an Apple or a TRS-80 to play with. Seems like it might have been a dull way to live. Yet it was really during this period that the theories that make micros work today were being postulated.

Imagine, if you will, a man working by gaslight over his desk developing theories that are being put into practice today. The thought of someone having that much insight so many years ago is mind boggling.

However, today in this issue we are talking about Robotics, the most ambitious of technological endeavors. Possibly the work that is being done today on a minor scale will cause the development of a true android of the future.

The idea of a real robot is probable in the future, but not within the next few years. But with the rapidly expanding depth of technology, not just in electronics, but also in mechanics, the day becomes even nearer.

## A FAIRLY SLICK PROGRAM

Recently, the Programming Shop, P.O. Box 11219, Palo Alto, California 94306, (213) 321-9621, sent me a copy of their ACT-I SOFTWARE — HOME MONEY MANAGEMENT SYSTEM. This program is for the TRS-80 Level II. The system is not disk interactive but uses the cassette system. The program is well written and extremely fast. The authors have made use of just about every programming technique you can imagine to achieve maximum throughput and functioning of the program.

Utilizing the Home Management System, you can keep track of credit cards, daily expenses, fixed expenses and the balance of your checkbook. The only problem I find with the program is that it is a little over priced at $79.90. But it does perform all the functions described in the user's manual.

## SOME MORE CONSULTANTS

When I requested consultants write to me in the August 78 issue, I really didn't expect to have so many answers, as can be testified to by previous Notebooks and Letters to the Editor. Every day now I get at least one more letter from another consultant, and so it has been for the past several weeks. For everyone interested, here are some more:

Edgewood Computer Associates, Inc.
51 Strawberry Hill Road
Hillsdale, NJ 07642
(201) 664-1480 Attn: Walter Levy

Edgewood specializes in the area of telecommunications, but has a great deal of expertise in financial and accounting applications. They help clients plan and implement systems that best fit their needs.

The Rush Company
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(213) 248-3315 Attn: Lynn Barton, President

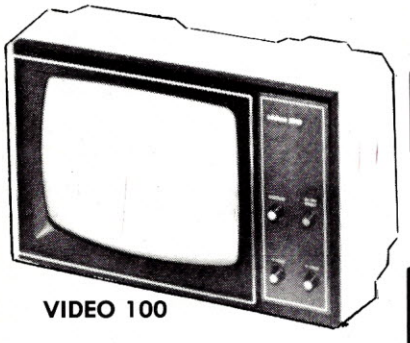
The Rush Company provides expertise in system design both hardware and software. They particularly enjoy doing custom hardware design or modifications.

Norman I. Weiner P.E.
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851 80th Street
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This company has developed application software for construction, foundation design, roadway and utilities design, economic evaluation and decision making, land development, and marine design.

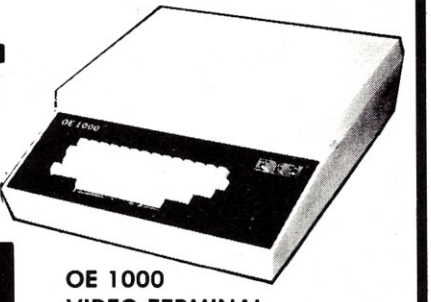
Michael C. Harris
Davis & Elkins College
Elkins, WV 26241

Professor Harris does consulting in the areas of business and health care applications. He provides services that run from initial design to implementation of the debugged system. This fellow has to be OK since he comes from just up the road from my birthplace of Parkersburg.

VIDEO 100

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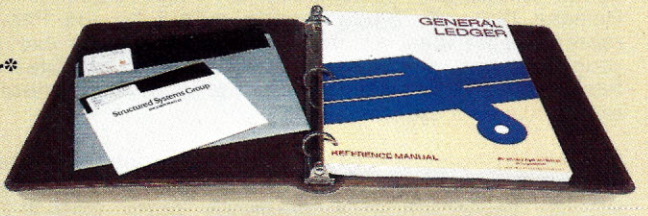
Our software will power DYNABYTE, CROMEMCO, IMSAI, NORTHSTAR, ALTOS, MICROMATION, DIGITAL SYSTEMS, or other Z-80 or 8080 based computers through your General Ledger, Accounts Receivable, and Accounts Payable. And maintain a conversational data-base query system, store and print your mailing list and labels, produce and edit correspondence, address it from your mailing list, and more. The price for a total system—hardware and SSG software—ranges from $8,000 to $14,000.

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Your computer retailer can give you a demonstration and literature. You might find a solution just right for your business with "off the shelf" prices and delivery times. Or we will be happy to send you literature direct, including a list of our dealers and compatible hardware. Write us, or call.




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| **General Ledger** | **LETTERIGHT Letter Writer** |
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* Complete prices will vary with equipment and software selected. Required: 8080 or Z-80 based computer running a CP/M or CP/M-compatible disk-based operating system. Your retailer or SSG can advise on specifics. (CP/M is a product of Digital Research.)

Automated Professional Systems Inc.
12832 Valley View, Suite 202
Garden Grove, CA 92645
(714) 638-0980 or (714) 891-3516 Attn: Peter R. Jax

APSI provides consulting and software services to small businesses ranging from selecting the appropriate system to providing a customized solution to the problem at hand. They are more than anxious to have interested businessmen drop in.

James H. Foy Enterprises
205 College Street
Farmersville, TX 75031
(214) 782-7282 Attn: James H. Foy

This company is specializing in a field that we have had many requests from readers about, metal working. Mr. Foy's company has developed the expertise to understand both the computer and the needs of the metal industry. They provide software for the TRS-80 that can be used maintaining production status and planning the work load. They have picked an unusual area and from the information sent to me, can provide more than adequate software and hardware support.

## A GOOD BOOK ON BASIC

Like any other editor, I receive a number of books for review. I personally very rarely review one myself, unless it's by Bob Albrecht; then I feel it's my duty. I mention this since I feel to talk about a book you must have some guidepost to work from. In my case, all books on BASIC must measure up to the books written by Bob Albrecht, because let's face it, Bob is probably the best educator in the industry and has written some of the best selling books on BASIC around.

The book that met all my personal criteria and measured up to an Albrecht standard is "BASIC and the Personal Computer" by Thomas A. Dwyer and Margot Critchfield, published by Addison-Wesley. It is available from all computer stores and several commercial bookstores.

This book makes a very important assumption, that you bought the book to learn about BASIC. Each and every chapter is written in an easygoing, understandable style that rivals even Mr. Albrecht. The book begins at the beginning in that BASIC is explained and the functions are built upon as you progress through the book.

Esoteric items such as binary numbers and 2's complements are explained in such a manner that even a sixth grader could understand the concept, although a mature reader won't be alienated. The only thing bad that can be said about the book is the number of typos that were found, but that can be overlooked when the contents are fully digested and enjoyed.

## SOME CHANGES

I have mentioned previously that as time went by we would be fine tuning the pages of INTERFACE AGE to better meet your needs. As a result of your letters, and responses to questionnaires, The Column will now be a potpourri of interesting articles. Some months, such as this issue, it will contain a light-hearted story that reflects the general theme of the issue. Other months The Column will have information for the Apple or TRS-80 user.

We are striving for a balance in the magazine that best reflects what you as INTERFACE AGE readers want and expect. Over the next several months you can expect to find issues dedicated to micros and the handicapped, graphics, and the OEM, plus more and more software.

## I WANT TO HEAR FROM YOU

This time around I would like to hear from your DP professionals who have expertise in different levels of computer systems, i.e. IBM System 3, and programming skills. The reason for this is companies contact me daily for names of professionals, particularly programmers, who might be interested in a new job. So if you are in the market, send me a short note with your name, address and telephone number, and level of expertise. During the next several months I will collect these inputs and publish them as a guide to headhunters. Also we would like to hear from all the readers.

carl





The new Pascal Computer System is driven by a unique 16-bit Pascal MICROENGINE™ — the first microprocessor hardware designed exclusively for direct high-level language execution. ■ The processor is incorporated into a single board computer system, the WD/90, which directly executes Pascal intermediate code generated by the University of California at San Diego (UCSD) Pascal compiler, Release III.0. ■ Since P-code output by the Pascal compiler represents an ideal architecture for a computer executing Pascal programs and since the WD/90 directly executes P-code (no interpreter), these programs execute up to five or more times faster than equivalent systems.

The WD/90 Pascal MICROENGINE™ Computer includes: ■ Pascal MICROENGINE™ processor ■ 64K bytes of RAM Memory ■ Two RS-232 asynchronous/synchronous ports (110-19.2K baud-full duplex) ■ Two 8-bit parallel ports (500 kHz maximum data rate) ■ Floppy disk controller with direct memory access (DMA), switch selectable for: single or double density (IBM format); mini or standard floppy; 1 to 4 drives (same type) ■ Floating point hardware (proposed IEEE standard) ■ Memory Mapped I/O ■ Enclosed power supply ■ Complete UCSD Pascal Operating System (Release III.0)

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**CIRCLE INQUIRY NO. 63**

# How to buy a personal computer.

Suddenly everyone is talking about personal computers. Are you ready for one? The best way to find out is to read Apple Computer's "Consumer Guide to Personal Computing." It will answer your unanswered questions and show you how useful and how much fun personal computers can be. And it will help you choose a computer that meets your personal needs.

## Who uses personal computers.

Thousands of people have already discovered the Apple computer—businessmen, students, hobbyists. They're using their Apples for financial management, complex problem solving—and just plain fun.

You can use your Apple to analyze the stock market, manage your personal finances, control your home environment, and to invent an unlimited number of sound and action video games. That's just the beginning.

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## How to get one.

The quickest way is to get a free copy of the Consumer Guide to Personal Computing. Get yours by calling 800/538-9696. Or by writing us. Then visit your local Apple dealer. We'll give you his name and address when you call.

*Apple II plugs into any standard TV using an inexpensive modulator (not included).




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CIRCLE INQUIRY NO. 3

In California, call 800/662-9238.

# LETTERS TO THE EDITOR

## IDEAS ON THE 9900

Dear Editor:

Readers who wish their microcomputer CPU had a better instruction set might be interested in some unexploited features of the TI9900 chip. Theoretically it would appear feasible to make the 9900 work as a true stack machine instead of as a register machine, by adding a few TTL ICs to the interface between the CPU and system memory. Because the 9900 uses the memory for its register storage, the potential exists to alter how it uses those registers and give them a stack architecture. There accumulator R0 is always on top of a stack, whose location shifts as the stack expands and contracts. Each time R0 is read, the stack is pulled and each time it is loaded the stack is pushed. At the same time, R1 always references the next-on-top position of the stack, R2 the position below that, and so on (R5 to R16, say, remain unaltered to provide index registers).

To get this effect you would need a 15-bit latch, comparator, adder, and counter (about a dozen ICs). The latch holds at all times a copy of the 9900 Workspace Pointer. The comparator signals when a value on the 9900 address pins equals the latched WP, i.e. references R0, determining whether the rest of the circuit is to be enabled. The address signals are combined in the adder with the output of the counter, which provides a zero base stack pointer. The counter is clocked up/down on each R0 access to expand and contract the stack. The offset address output from the adder goes to memory in place of the actual 9900 address signals, causing register references to operate on a dynamically changing location in memory.

The 9900 can also be made to automatically distinguish globals and locals. Although the indexed addressing modes do this partially already, they require more time to execute, and use up the indexing capability. For faster operation the high address bit of an addressing operand could indicate global or local type. Instruction code and globals are then restricted to one half of the available address space, and locals to the other half. Locals would cause all addresses to be indexed off the Workspace Pointer using the same latch and adder again to transform address signals. The indexing mode of the 9900 itself is then available for an additional degree of address handling within a local environment.

In the absence of an inexpensive stack-architecture CPU such a circuit may be an alternative. Unfortunately, it does not come as a single IC support chip for the 9900 family.

George Lyons
280 Henderson Street
Jersey City, NJ 07302

## A GOOD WORD

Dear Editor:

I have ordered a great deal of software for my North Star system, and I want to say that Supersoft is the best in my book.

Prompt service and quality are their trademarks.

Ken Kevin

## LOOKING FOR A SYSTEM

Dear Editor:

I've been a subscriber to INTERFACE AGE for a while, in addition to several other similar magazines. I own nothing in the way of a computer, yet. I once took a course in FORTRAN and enjoyed it (although I'm willing to switch to BASIC if necessary). I know enough electronics to be able to get a Ham Novice license, but not to do "trouble-shooting" etc. I've put together a binary counter from "scratch," way back when this was done with many separate transistors.

I'd like to do some statistical research with a computer. If I had a spare $3,000, I wouldn't be writing to you now. I really don't have that sort of money to spare.

In your December 1978 issue I note the advertisement for the "Rockwell AIM 65." I hope that you will review this in the near future inasmuch as it looks like just what I'd like, providing:

- it has good reliability (i.e., it works constantly and consistently)
- it can take a good memory (i.e., large), and
- it has a good BASIC (not one of these cut-down things), and I might eventually (in the distant future) be able to add some disk storage.

Of course, a good manual and other documentation are important.

I enjoy your publication.

Edwin Kooser
P.O. Box 63
Flagtown, NJ 08821

*Edwin, we currently have no plans to review the AIM 65, but the possibility does exist.*

## IDEAS ON CONSTRUCTION

Dear Editor:

Technology often moves faster than we realize; as an example, I direct your attention to page 117 of the December 78 issue of INTERFACE AGE. While describing the construction of the H-11 microcomputer kits, the author states . . .

"Those with no previous soldering experience should practice on something simple and inexpensive, such as a digital clock kit."

Until 10 years ago, very few people had even seen an electronic digital clock; as recent as 2 or 3 years ago, relatively few people owned one. Now, thanks to LSI and mass-production techniques, this electronic miracle has been reduced to a "simple inexpensive" kit, suitable for beginners to cut their teeth on.

Please understand that I agree completely with the author that construction experience is essential in tackling a complex kit such as the H-11. I just wanted to point out that the marvel of yesterday can become the commonplace of today and the necessity of tomorrow.

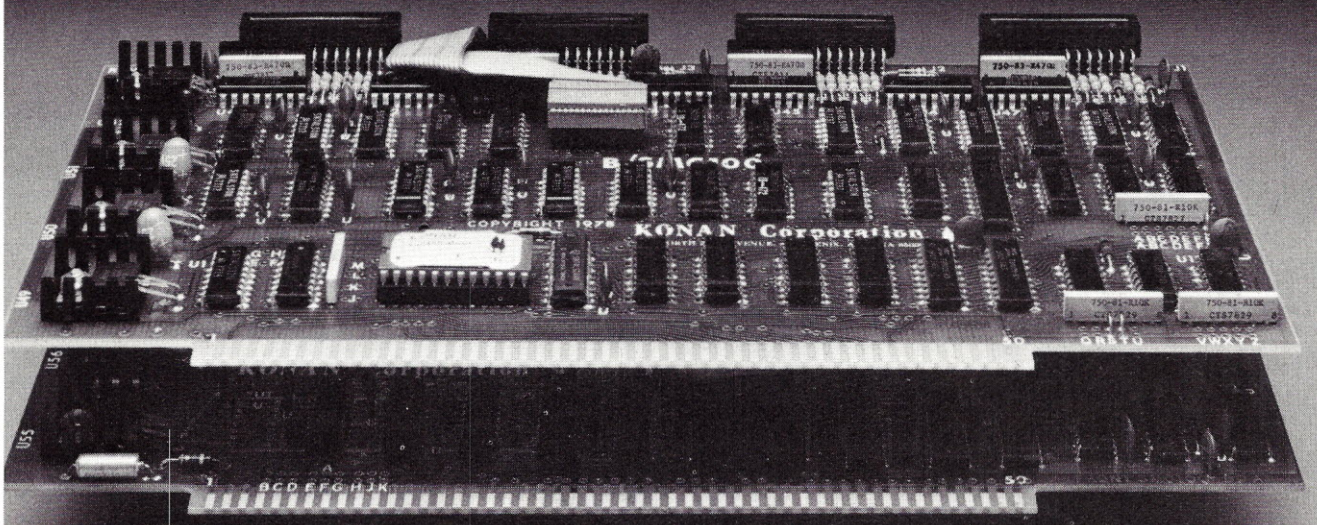
Keep up the good work! (it makes the cold winter pass easier!!). Also, any plans for Floppy ROMs in future issues? How about some with TRS-80 or PET programs?

Milan D. Chepko, M.D.
Thief River Falls, MN

*Doctor, yes we have plans for more ROMs and surprisingly enough for the TRS-80.*




# UP TO 1200 MEGABYTES OF HARD DISK CONTROL FOR THE S-100 BUS




## It's versatile. It's fast. It's cost efficient.

It's Konan's SMC-100. The disk controller that brings S-100 bus micro computers together with large capacity hard disk drive.

**Versatile.**
It'll interface S-100 bus micro computers with all fixed or removable media disk drives with storage module (SMD) interfaces. These drives range from 10 to 300 megabytes per drive, including most "Winchester" type drives. Each Konan SMC-100 will control up to 4 drives . . . that's up to 1200 megabytes of hard disk per controller. And the SMC-100 let's you take your pick of hard disk drives (Control Data, Fujitsu, Microdata, Kennedy, Memorex, Ampex, and Calcomp, for example).

The SMC-100 works with your micro computer. It'll wait for your memory — it allows intermixing of slow and fast memories. It uses standard I/O instructions. And the optional driver ROM, addressed through descriptors, allows the SMC-100 to handle all disk interfacing, including error recovery and bad track mapping.

**Fast.**
The SMC-100 transfers data at high speed, 6 to 10 megahertz rates, with full on-board sector buffering and sector interleaving. Its 2 cycle DMA is faster than most S-100 DMA controllers which use 3 or more processor cycles per byte.

**Cost efficient.**
The SMC-100 takes advantage of low cost-per-megabyte disk drive technology making the typical cost per megabyte about $100.

**And the price is right.**
The SMC-100 is a fast, efficient and versatile hard disk controller. It allows you to use low cost-per-megabyte technology. And, it's priced to keep your micro computer system micro-priced.

The O.E.M. single quantity price is only $1650, with driver ROM option. And excellent quantity discounts — and complete subsystems — are available.

**Dave Baughman has the answers. Talk to him today. You can call him on Konan's order number: 602-269-2649. Or write him at Konan Corporation, 1434 N. 27th Avenue, Phoenix, Arizona, 85009.**

# KONAN

**1434 N. 27th Avenue • Phoenix, Arizona 85009 • 602-269-2649**

# "My Shugart followed me home."




"After working all day with the computer at work, it's a kick to get down to Basic at home. And one thing that makes it more fun is my Shugart minifloppy™. We use Shugart drives at work, so when I bought my own system I made sure it had a minifloppy drive.

"Why? Shugart invented the minifloppy. The guys who designed our system at work tell me that Shugart is the leader in floppy design and has more drives in use than any other manufacturer. If Shugart drives are reliable enough for hard-working business computers, they've got to be a good value for my home system.

"When I'm working on my programs late at night, I can't wait for cassette storage. My minifloppy gives me fast random access and data transfer. The little minidiskettes™ store plenty of data and file easily too.

"I made the right decision when I bought a system with the minifloppy. when you lay out your own hard-earned cash, you want reliability and performance. Do what I did. Get a system with the minifloppy."

## If it isn't Shugart, it isn't minifloppy.

Shugart

435 Oakmead Parkway, Sunnyvale, California 94086

**See opposite page for list of manufacturers featuring Shugart's minifloppy in their systems.**

**TM minifloppy is a registered trademark of Shugart Associates**

## A COMPUTER WIDOW?

Dear Editor:

I agree with Sandra Evans (INTERFACE AGE, January 1979) that wives are often ignored when husbands begin their computer hobby.

What I find objectionable is the assumption that a wife should, to preserve the marriage, become interested in her husband's mania. It is obviously the responsibility of the computer enthusiast to demonstrate that this expensive marvel of modern technology has any practical value in the home (See INTERFACE AGE, December 1977, for ideas and programs.)

For example, my husband and I discussed possible uses for our computer and we came up with a list of things for him to program and to assemble so the computer would be useful to me. I have little interest in the hobby but great interest in my husband. As long as he is spending his time with the computer and not with me, let it be on something which can ultimately assuage my resentment.

Why should a wife be treated as less important than a husband's hobby? Keep in mind how important she is to you and treat her with the respect and consideration with which you ask to be treated.

Reba Silterra
Urbana, IL

## SOME THOUGHTS ON "FINANCIAL ANALYSIS"

Dear Editor:

I recently ran across an article in your magazine entitled "Financial Analysis. . .in Basic" (3/78). I would like to propose two additional calculations that I have found to be very useful. The first is to compute the principal of an annuity in period k, prior to the maturity of the annuity. The second is to compute the principal part of a payment in some period k. Following the author's notation the calculations are:

$$1.\ Pr = \frac{(1 + i/c)^k - 1}{(1 + i/c)^n - 1} PV$$

$$2.\ Pp = \frac{(1 + i/c)^{k-n} - (1 + i/c)^n}{i/c} P$$

Where

Pr is the total principal in period k,

Pp is the principal part of the payment in period k.

Accordingly, . the associated interest amounts are kP-Pr and P-Pr respectively.

Although these expressions probably exist in standard textbooks, I have never seen them. Perhaps the author would like to include these in any follow-up article. I think it would also be nice if he would include a simple iterative routine to calculate the interest rate for an annuity.

George R. Booth
Springfield, VA

## MR. BURKE ANSWERS

Dear Editor:

In reply to questions asked by Mr. Booth:

Q: Calculate the principal remaining on an annuity before its maturity?

A: The program will handle this without any trouble. The remaining balance on a loan is equal to the present value of its remaining payments discounted at the given rate of interest. Assume we have a loan for $40,000 at 10% interest for 25 years with monthly payments. We can use my program and calculate the payments to be $363.48. If we want to know the remaining principal when there are 10 years left to go we simply enter the present value of 0, an interest rate of 10, a payment amount of 363.48, future value of 0, compounding to 12, and a type of 0, and set the number of periods to (10 × 12) 120. The program will then calculate the present value to be $27,504.98 which is the unpaid or remaining balance on the loan.

Q: Calculate the principal part of a payment for a given payment?

A: To solve this problem you can use the part of the program which will print out an amortization schedule. When you do this you will get output as on page 51 (INTERFACE AGE, March 78). You can then look at the payment number and determine the principal and interest for that payment. Because the program allows you to enter the payment to start printing on, and the payment to stop printing on, you can force it to print only one payment, and thus do not have to print an entire schedule to find your answer.

Q: Routine to calculate the interest rate on an annuity?

A: This routine is already in the program, you can calculate the interest rate on annuity. The example which starts on page 50 and ends on page 51 calculates the interest rate to be 9.75%.

I hope that this answers the questions for Mr. Booth.

Peter M. Burke
Salt Lake City, UT

## THERE ARE "HAPPY" CUSTOMERS

Dear Editor:

After having had several bad experiences with software dealers, I would like to report a very good one. I own a SOL/20 with North Star Disk. The dealer is Supersoft, P.O. Box 1628, Champaign, IL 61820. I have bought several programs from them now and they all work more than satisfactorily. More importantly, however, is the quality of service and the willingness of Huber Schildt, the manager, to help with any problems that I had. None of these problems, by the way, related to their product.

M. Blair Sibley
Albany, NY


**Look for Shugart drives in personal computer systems made by these companies.**

**Altos Computer Systems**
2378-B Walsh Avenue
Santa Clara, CA 95050

**Apple Computer**
10260 Bandley Dr.
Cupertino, CA 95014

**Digital Microsystems Inc.**
(Formerly Digital Systems)
4448 Piedmont Ave.
Oakland, CA 94611

**Imsai Mfg. Corporation**
14860 Wicks Blvd.
San Leandro, CA 94577

**Industrial Micro Systems**
633 West Katella, Suite L
Orange, CA 92667

**North Star Computer**
2547 9th Street
Berkeley, CA 94710

**Percom Data**
318 Barnes
Garland, TX 75042

**Polymorphic Systems**
460 Ward Dr.
Santa Barbara, CA 93111

**Problem Solver Systems**
20834 Lassen Street
Chatsworth, CA 91311

**Processor Applications Limited**
2801 E. Valley View Avenue
West Covina, CA 91792

**SD Sales**
3401 W. Kingsley
Garland, TX 75040

**Smoke Signal Broadcasting**
6304 Yucca
Hollywood, CA 90028

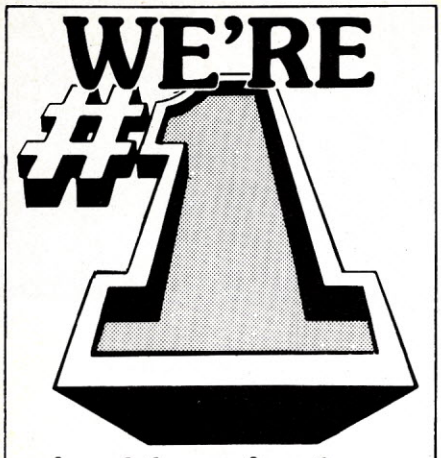
**Technico Inc.**
9130 Red Branch Road
Columbia, MD 21045

**Texas Electronic Instruments**
5636 Etheridge
Houston, TX 77087

**Thinker Toys**
1201 10th Street
Berkeley, CA 94710

**Vista Computer Company**
2807 Oregon Court
Torrance, CA 90503

Shugart




**And here's three more reasons why . . .**

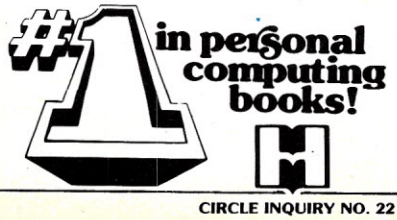
**SARGON: A Computer Chess Program** (Spracklen) offers *the* chess program that won first prize at the 1978 West Coast Computer Faire Chess Tournament! In book form (#5155-7, $14.95) or on computer program tapes (#00603, TRS-80 Level II, $19.95; #00604, Apple II, $19.95).

**BASIC MICROPROCESSORS AND THE 6800** (Bishop) gives you two books in one: a basic guide to microprocessors for the beginner, and a complete description of the M6800 system for the engineer. (#0758-2, $11.95).

**SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS** (Spencer) will sharpen your programming skills through games, puzzles, science problems, business problems, and mathematical recreations. (#5180-8, $6.95)

These three books add luster to Hayden's reputation as being #1 in personal computing books! Check them out at your local computer store!

**Hayden Book Company, Inc.**
50 Essex Street,
Rochelle Park, NJ 07662




CIRCLE INQUIRY NO. 22


## A SORE SPOT

Dear Editor:

In your December Letters to the Editor, Mr. Beetem (an electronist and computist), scratched a grammatical sore which has been festering since the first microcomputer magazines came out.

If x is an activity in which people may engage, then the suffix -ist, like the suffix -er, creates a word (x-ist, x-er) describing a person who engages in that activity. For example one who engages in a hobby is a hobbyist, right?

Not according to the editors of most microcomputer magazine articles and advertising copy — it's "hobbiest"! Boo, hiss! The suffix -est creates a superlative. For example, of all hobbies, microcomputing is the hobbiest.

Please, let us have our hobbyists back.

Joseph Dawes
Big Spring, TX

## ANOTHER "GOOD GUY"

Dear Editor:

After reading so many complaints (and suffering from the same problem myself) about vendors of computer peripherals. I'd like to salute one of the "Good Guys" of the industry. We're always quick to condemn, but how many of us take the time to give praise when someone's worked hard to earn it?

I nominate for "The Good Guy of the Month" Warren Rosenkrantz, superstar of V R Data Corporation in Folcroft, PA. After dealing with several other rather questionable firms, I received a flyer from V R Data congratulating me on the purchase of my Radio Shack TRS-80 and listing several peripherals at very attractive prices. I investigated and, to make a long story short, began what I hope to be a long and rewarding business relationship.

Warren and his staff exhibited a willingness to help a fledgling computerist. They brought back that old, forgotten trait that makes good business men great — the customer comes first. Sure, like everyone else in this mad industry, we had problems — printer modifications that didn't work, the disk drive that gave weird results. However, Mr. Rosenkrantz spent considerable time and effort to correct these problems and, together, I think we both learned a lot. He's also very knowledgeable in the field of electronics and is quickly becoming a pro on the TRS-80. What do you expect from a guy who starts work at 5:30 A.M. and sometimes doesn't quit until after 10 at night?

Clifford W. Coughlin
Upper Darby, PA

## C.A.I. MATERIAL NEEDED

Dear Editor:

The Florida Educational Computing Project, which is supported by the State of Florida, has recently approved a project for the evaluation and implementation of a microcomputer based instructional computing system. As a member of the evaluation committee, I am writing to you in the hope that by publishing this letter we will be able to contact those among your readers readers who have education oriented software developed for microcomputers.

We are looking for both CAI-type material and administrative support programs (e.g. film library inventory/control, word processing, statistical analysis, etc.). We do not have the funds to purchase any software at this time and would, therefore, be willing to certify the return or destruction of any program material loaned to us if necessary.

Because of the variety of possible computers these programs may run on, we would prefer those which are not too dependent on a particular hardware configuration or operation system (if one is required). However, we would like to hear about any such programs running on 6502, 6800, or 8080/8085/Z-80 machines.

The outcome of this project will be a catalog listing all the acceptable software packages we receive, their evaluation and their source of distribution. This catalog will be made available to all educational institutions in the State of Florida and to any other interested educational systems. Naturally we would like to share with those who contribute software for evaluation, possibly starting an exchange program among the participants.

Any help which we receive would not only be greatly appreciated, but would accelerate the exposure, use, and knowledge of microcomputers in general. We feel that the microcomputer, because of its relative small size, low cost, and dedicated one-on-one responsiveness, will prove to be a powerful learning tool for the student and a valuable time-saving aid to the educator.

Those who have software they wish to submit for evaluation and inclusion in our catalog or those who have questions concerning our project may please contact:

Dr. Nelson J. Towle
Sarasota County Schools
2409 Hatton Street
Sarasota, FL 33577
(305) 953-5000, Ext. 322

We hope with the cooperation of your magazine and your readers that our efforts will show in the field of education that the microcomputer is "an idea whose time has come."

Paul G. Bunnell
Lake Worth, FL

## TRS-80 OWNER NEEDS HELP

Dear Editor:

We have a TRS-80 (48K) with disk and the Radio Shack RS 232 interface. We want to connect it to a Diablo 1620-3.

The DECwriter Software, supplied by Radio Shack (with slight changes to 48K), supports communication from the computer to the printer, but not from the Diablo to the TRS-80. Can anyone help?

William A. Perry
Box 392
Whitinsville, MA 01588



**Specifications:**
S-100 compatible. MFM encoding, 35 tracks with ten 512-byte sectors per track. 179,200 bytes on double density SA-400 and North Star BASIC, DOS, and Monitor included.

**For further information,** write for full color catalog or contact your local computer store.

## New from North Star

# Double Density Performance at Single Density Prices

The new HORIZON computer and Micro Disk System now record in double density! That means each new Shugart SA-400 minifloppy disk drive accesses 180K bytes of on-line information. All double density HORIZON computers and Micro Disk Systems have a redesigned controller which allows the use of quadruple capacity disk drives as they become available in early 1979. A three-drive North Star System with quadruple capacity disk drives will access over a megabyte of on-line information. But, best of all there's no price increase for double density models.

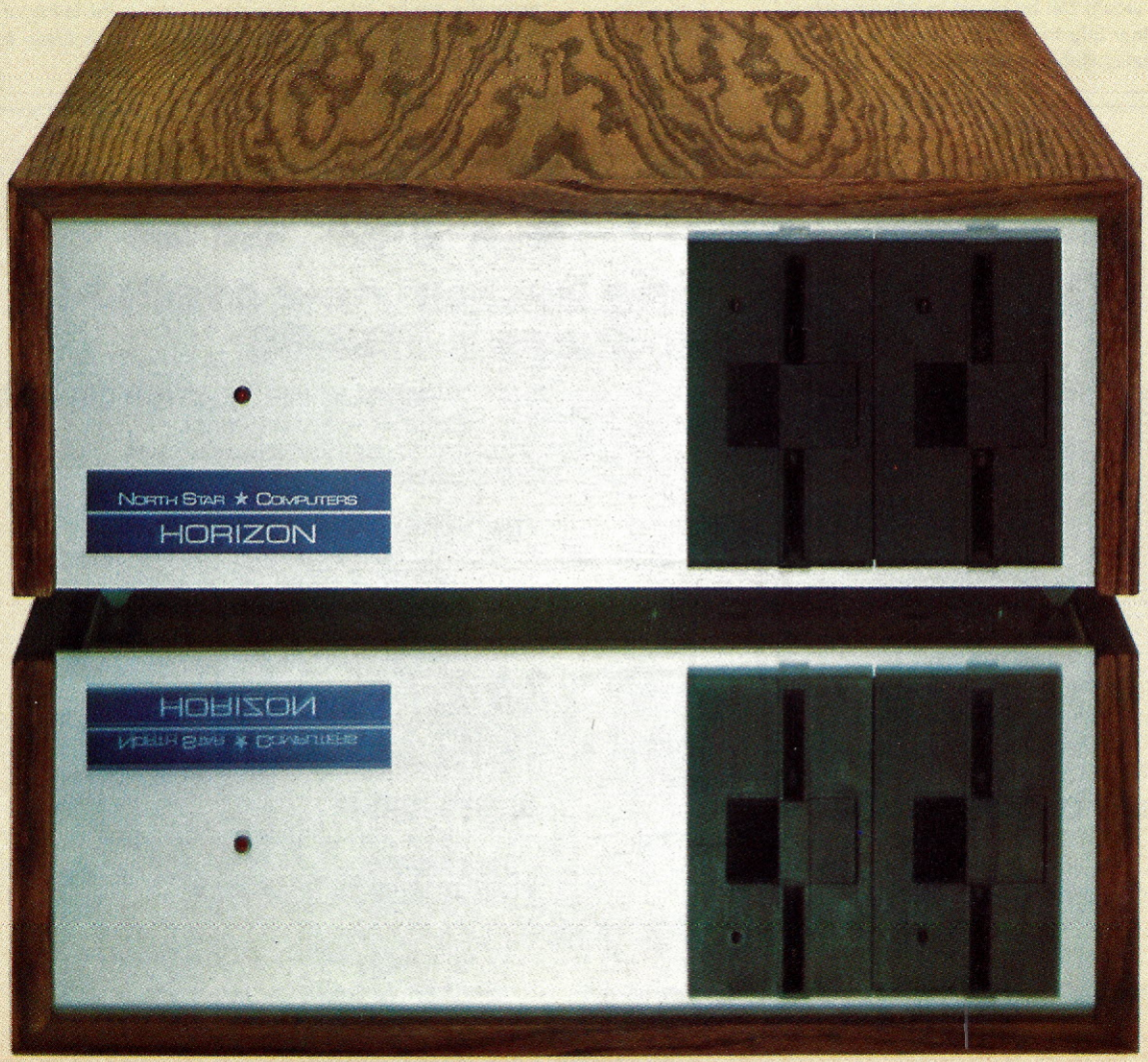
North Star BASIC and DOS have been upgraded to accommodate the increased capacity and yet run existing programs with little or no change. The new disk system also supports single density, so existing single density diskettes can still be used. Single density SA-400 drives previously purchased with North Star systems can also be used.

**Pricing**

HORIZON with one double density SA-400 minifloppy (180K bytes), 16K RAM, Z80A processor and serial I/O port: $1599 kit, $1899 assembled.

MICRO DISK SYSTEM with one double density SA-400 minifloppy, controller board and power regulation: $699 kit, $799 assembled. (Cabinet and power supply $39 extra each.)

NORTH STAR ★ COMPUTERS
2547 Ninth Street
Berkeley, California 94710
(415) 549-0858



# INDUSTRY MEMO

This column traditionally concerns the microcomputer industry, with a follow-up on new products or literature. Since this is the annual issue on robotics, it seems fitting to describe events dealing with robots. While the recent popularity of robotics is a direct result of the implementation of microprocessors, interest in robotics predates even the earliest computers. These early creations are of little interest to the presentday robot enthusiast.

Because of the many advances in the field of robotics, these inthusiasts require a 'clearinghouse' for robot oriented literature, hardware, and software. There are several robotics organizations that may be of interest to the hobbyist or professional. One of the earliest formed, which should appeal to all with an interest in robots, is the United States Robotics Society. Based in Albuquerque, home of the original MITS *Altair* that started it all, the U.S.R.S. is devoted entirely to collecting and distributing information about robotics. The society publishes a monthly newsletter filled with news of all those androids that seem to be springing up around the country. Because of growing pains, an occasional month goes by without a newsletter, only to be made up later with the membership receiving a special issue or a free book.

It is precisely because of these growing pains that an agreement has been reached between the board of directors of the U.S.R.S. and Gallaher Research Inc. of Winston-Salem, N.C. G.R.I. will assume publishing of the U.S.R.S. newsletter, possibly by late spring of this year. Gallaher Research is the maker of the "Grivet" and other indusrtial robots mentioned in this issue of INTERFACE AGE. This would mean expansion of the newsletter into a magazine and enlargement of the society's present membership and activities. The U.S.R.S. would still be based in Alburquerque.

For further information, contact: Glenn Norris, (505) 299-4676, United States Robotics Society, P.O. Box 26484, Alburquerque, N.M. 87125 or, in the West Coast area: Tom Carroll, 7025 El Paseo, Long Beach, CA 90815.

Another organization dealing with the study of robotics is The International Institute for Robotics. The I.I.R. publishes a robotics newsletter which covers quite a bit on actual robot construction. The director, T.D. Cowsert, also offers a home study robotics course. The address is: P.O. Box 615, Pelaharchie, MS 39145, (601) 854-5339.

Several other groups geared to the amateur roboticist are being formed. These are on the level of local clubs and information on them is best obtained through one of the above mentioned newsletters.

On the industrial robot level, there is the Robot Institute of America. This organization is designed for the individual in industries dealing with production industrial robots and numerical control (NC) machines. This organization may be of interest to the hobbyist.

## Robot Books and Software

**Tab Books**, Blue Ridge Summit, PA 17214

Tab is offering new members in their Electronics Book Club, an enticing offering of four robot books for $1.99. These include: *Build Your Own Working Robot, Handbook of RC and Automation Techniques, Digital Interfacing in an Analog World, The Complete Handbook of Robotics.*

**Hayden Book Company, Inc.,** 50 Essex Street, Rochelle Park, NJ 07662. Hayden is now offering a cassette of robot software to be used with a KIM-1 (or any 6502 based system) in robot control. The programs are by John Loofbourrow. John is the father of Tod Loofbourrow, author of the accompanying book-*How to Build a Computer-Controlled Robot.*


# CP/M®+TRS-80®

## The CP/M Operating System now available for Radio Shack's TRS-80

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# GOOD BUY, OEM's!




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# CORRECTIONS

A command was misprinted in a July, 1978, article entitled *The Westminster XEK Assembler for North Star Disk* by Alan Miller. The corrected section of the article is listed below.

### LIBRARY FILES

You probably have sections of assembly language code that you frequently use, such as I/O routines and HEX-binary/binary-HEX conversions. These routines can be placed into a disk file of type .LIB and subsequently inserted into another file that is being edited. The command:

*R HEXBIN

copies the file HEXBIN.LIB from disk into the edit buffer, starting at the CP.

---

C. Gagliardi, General Manager of Active Design Laboratories, Hartford, Connecticut, had the following comments regarding two December 1978 articles:

The inexpensive EPROM programmer circuit displayed a few weaknesses. The author stated that "manufacturers don't make 26 volt regulator ICs." There is, however, the LM 723, a 2-37 volt regulator with an output up to 150 mA. A 723 is less than half the price of a $1.50 340. Also, the DC power supply used 1N4001 diodes which have a PIV of 50. A 35 volt (RMS) level is 50 volts peak. I would suggest using 1N4002s, which have a PIV of 100, instead.

In the same issue, the article on diabetes makes several references to "keytones." I believe the author means "ketones."

---

In *Burn Your Own PROMs* by Alan Miller (February 1979), Figure 1 was incorrectly labeled. The NOR element was erroneously called a NAND element. See figure below.

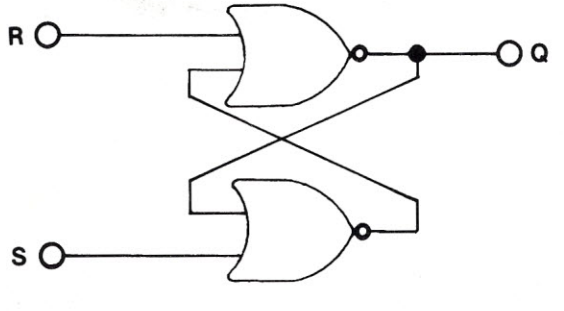
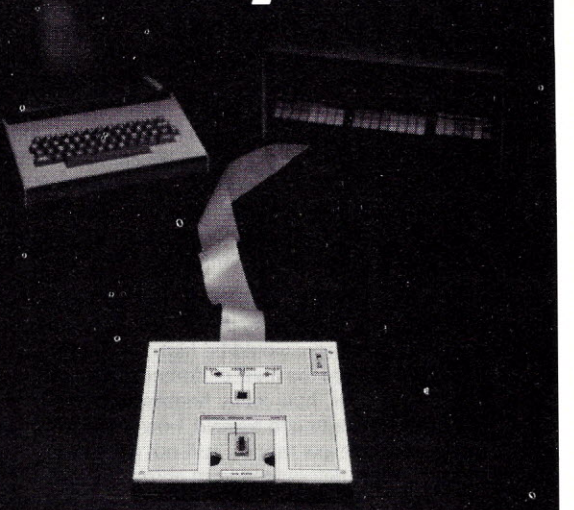



**Figure 1. A NOR bistable memory element.**


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CIRCLE INQUIRY NO. 46

# Ask Mr. Janeway

## Interview by Terry Costlow, Assistant Editor



**What do you see in the near future in the economy and what do you feel the effect will be on the small businesses such as the computer manufacturers?**

JANEWAY: We have an entirely new and unfamiliar situation inside the American economy. Its course and its trend are now dominated by the double-digit level of interest rates. The prime rate at 11¾ percent or above 11 percent is meaningingless. It's a public relations token. The average business borrower, especially the business borrower who's dealing through leasing operations, is paying 4 to 6 points above prime. That means we are looking at 20 percent interest rates. And for growth businesses that are having trouble conserving and accumulating capital, though they may not be paying taxes, this is a confiscatory rate of interest. It's crippling. And the only way it can be tolerated is on the bet that it won't last long.

**What aspects of the current situation are new and unfamiliar?**

JANEWAY: In the past, every difficult period has focused on a bet on how long interest rates would be high and the answer to that has been forthcoming from the level of domestic demand for credit. For the first time, however, how many houses are built, how many cars are on dealers' lots waiting to be sold, how many software computer operators want to borrow money, will not determine the level of interest rates. It will be determined from abroad by the exchange value of the dollar. This is the first time in history when a recession may see higher interest rates if the United States government does not figure out how to handle its political negotiations with other governments. Or alternatively, when a natural boom may bring a drop in interest rates. This is an entirely unfamiliar situation. It's a first.

In the Janeway Letter I've been trying to explain that if our government continues to operate the way it has been, we're going to get hit with a double whammy — lower business conditions, and nevertheless higher interest rates. Whereas, if we were to change our way of doing business — specifically, bartering our oil imports for, say, computer exports instead of paying cash — the very act of stabilizing the dollar would simultaneously boom the economy and depress interest rates; and we'd be on our way again.

**You're advocating the Japanese system?**

JANEWAY: That's right. Which we should adopt instead of the British system — the one we're on and which isn't working for us.

**Do you see that happening?**

JANEWAY: Not with this administration. The first chance is in 1981. Now, talking politics, I'm encouraged because there's a tradition in America, typified by the Lincoln-Douglass debates of 1860 and the Roosevelt-Wilkie debates of 1940, which sees both opponents converging on the same national line — indistinguishable positions. And we're getting that again. On the Democratic side, Kennedy has said we need to rip OPEC apart and draw on North American resources for oil. That sets up a barter system, because Mexico needs food yesterday, and we don't need oil — by anybody's account of it — until day after tomorrow.

And on the Republican side of it, Connally has got the same position. And once you have candidates converging on what the national interest requires, the country can't lose no matter who wins the election.

**But you don't foresee this happening before 1980?**

JANEWAY: It won't crystallize until 1980, and it won't happen until 1981, but I'm increasingly confident that it will crystallize in 1980 and it will happen in 1981. And it's important to have some sense of time and some sense of focus on where the end of the tunnel is when you're in a business that involves three to five year commitments, as the computer business does.

**What would you say is their best bet to cover themselves until 1981?**

JANEWAY: As they say in football, punt and hope for a fumble in 1979. Take a defensive stand and try to limit commitments. And then prepare for an anticipatory improvement in 1980 and a boom in 1981.

**Are you saying that for the next couple years that they should just stay in a holding pattern?**

JANEWAY: Yes. Get liquid, get equity, get out of short-term debt.

**What effect would you say the expansion of companies like Xerox and IBM will have on the microcomputer industry?**

JANEWAY: Well, that's where you're going to get great growth. Their expansion, I note, is increasingly intensifying the use of techniques like overnight Federal Express. I had Fred Smith of Federal Express in my Seminar the other day (the January Seminar in Washington). He said that even for a company like IBM, with $6 billion in excess cash, the cost of inventorying its 760,000 line items would be intolerable if they had to inventory every item at every location.

Fortunately, so much of their expansion is concentrated in miniaturization and micro items that they're able to minimize their inventory, which of course means minimizing their output demand level on their suppliers, by using the Federal Express technique — the overnight delivery guarantee for small items. And, of course, that kind of circulation in the economy is going to increase by leaps and bounds. But it illustrates my main point that when even IBM — which is as liquid as banks are supposed to be but rarely are — bases its entire operation on how to avoid tying money up in working capital and inventory, it behooves every small operator to do the same thing. IBM has figured out how to use new techniques to maintain a dynamic rate of sales expansion while tying up a minimum amount of capital in inventory.

**Do you think that with IBM entering the market the prices will be driven up or down?**

JANEWAY: Down. They'll come in everywhere and everyone will try to compete against them in price. And they'll try to hold their price by selling service, which is another way of cutting prices.□

*If you have a question for Mr. Janeway, write to: Ask Mr. Janeway, P.O. Box 1234, Cerritos, CA 90701.*

# COMING UP

The May INTERFACE AGE is packed with information for everyone. There are nine useful software articles in this blockbuster issue. Some of the packages are:

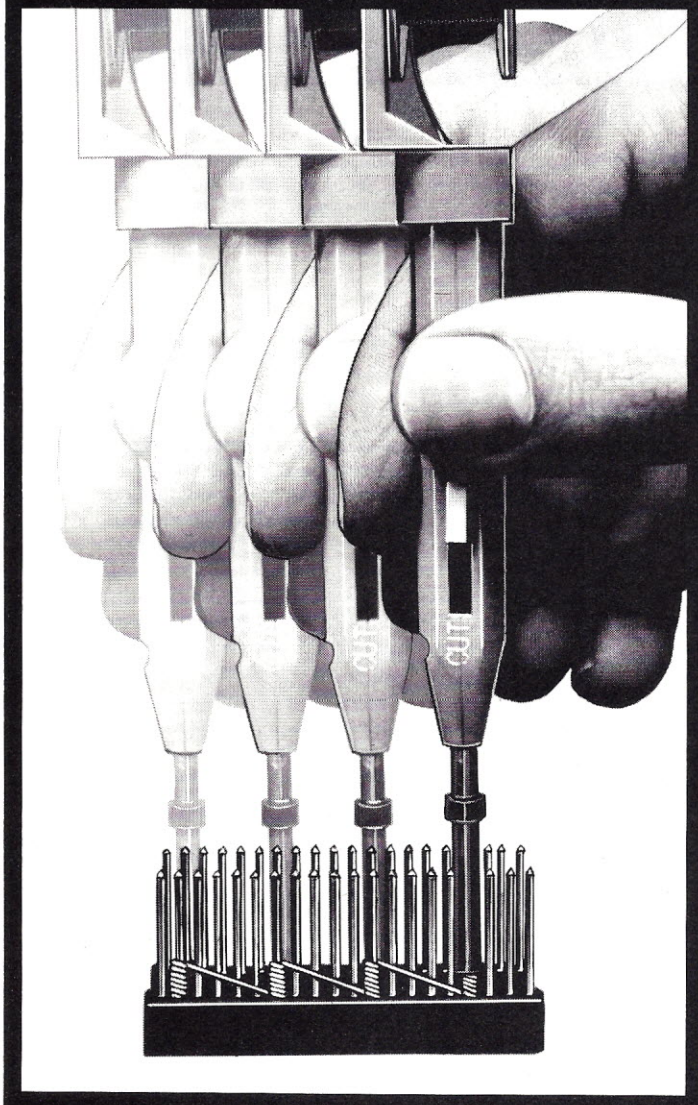
A Payroll Program
Statistical Analysis
Techniques for Interfacing to Commercial Software
Credit Programs
Name List Handling Techniques

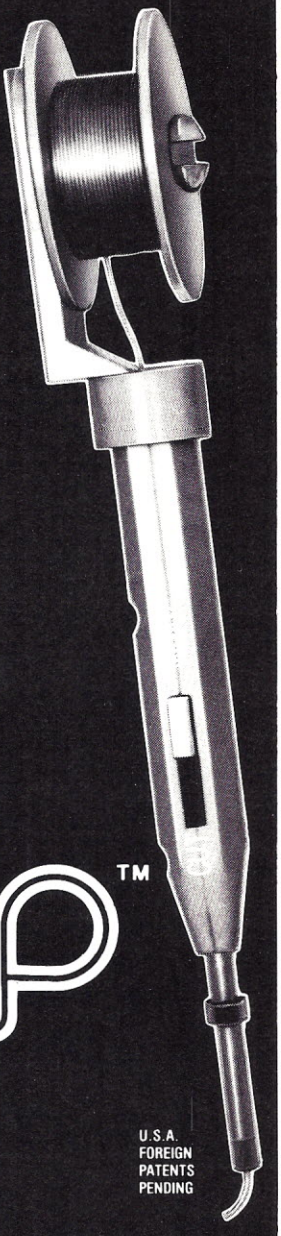
To make this one of the most useful business issues to date, there are also articles explaining double density recording and a look at the iCOM hard disk.

On top of all that, we have tutorials for persons at all levels of computer knowledge. The NTS Mini Series continues to explain the basics of computing, while Programming Techniques continues with Night Five.

Beginning with the June issue, INTERFACE AGE will be presenting a PASCAL tutorial by Associate Editor Henry Davis. This series promises to be the most authoritative source on PASCAL printed in any magazine. It even includes a complete PASCAL C compiler based on the P4 implementation.

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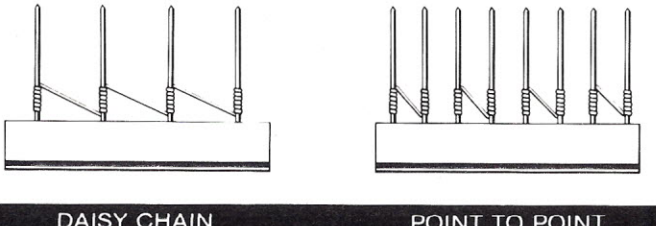
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CIRCLE INQUIRY NO. 30


# THE COLUMN

*The Column, as a result of letters and questionaire results, is now going to be a potpourri of articles. Some months, such as this issue, it will contain a light-hearted story that reflects the general theme of the issue. Other months The Column will contain TRS-80 or Apple user information.*

## By Leo Benedict

### THE PERFORMANCE

The curtain was down and the stage was dark as he waited to perform. For dramatic effect, he would already be in position when the curtain was raised and the spotlight focused on him. He could not see the audience, but he could hear them. People rustling about, finding their seats, removing their coats, chattering in anticipation.

This would be his first performance in public. He was curious about how the audience would react to him. He was not nervous, just curious. He wondered if his performance would be what they expected to hear. Would they be disappointed? Or would they be fulfilled? To him it did not matter. But there were others with great expectations about his future if this concert were a success.

A dim light glowed now. He could barely make out two figures approaching him. He knew who it must be. Yes, the two men who had worked with him, teaching him everything he knew. One final check to make sure everything was ready. He could tell they were nervous, and wondered why they could not be as calm as he. Everything would go exactly as they had planned. The only uncertainty was the audience, and how receptive they would be.

The chatter dwindled as the curtain slowly rose and the spotlight shone on him. Right on cue he began his performance. The music he played was original, yet hauntingly reminiscent of countless classical pieces of the past. Coolly, unemotionally he played the music that had been memorized just for this occasion.

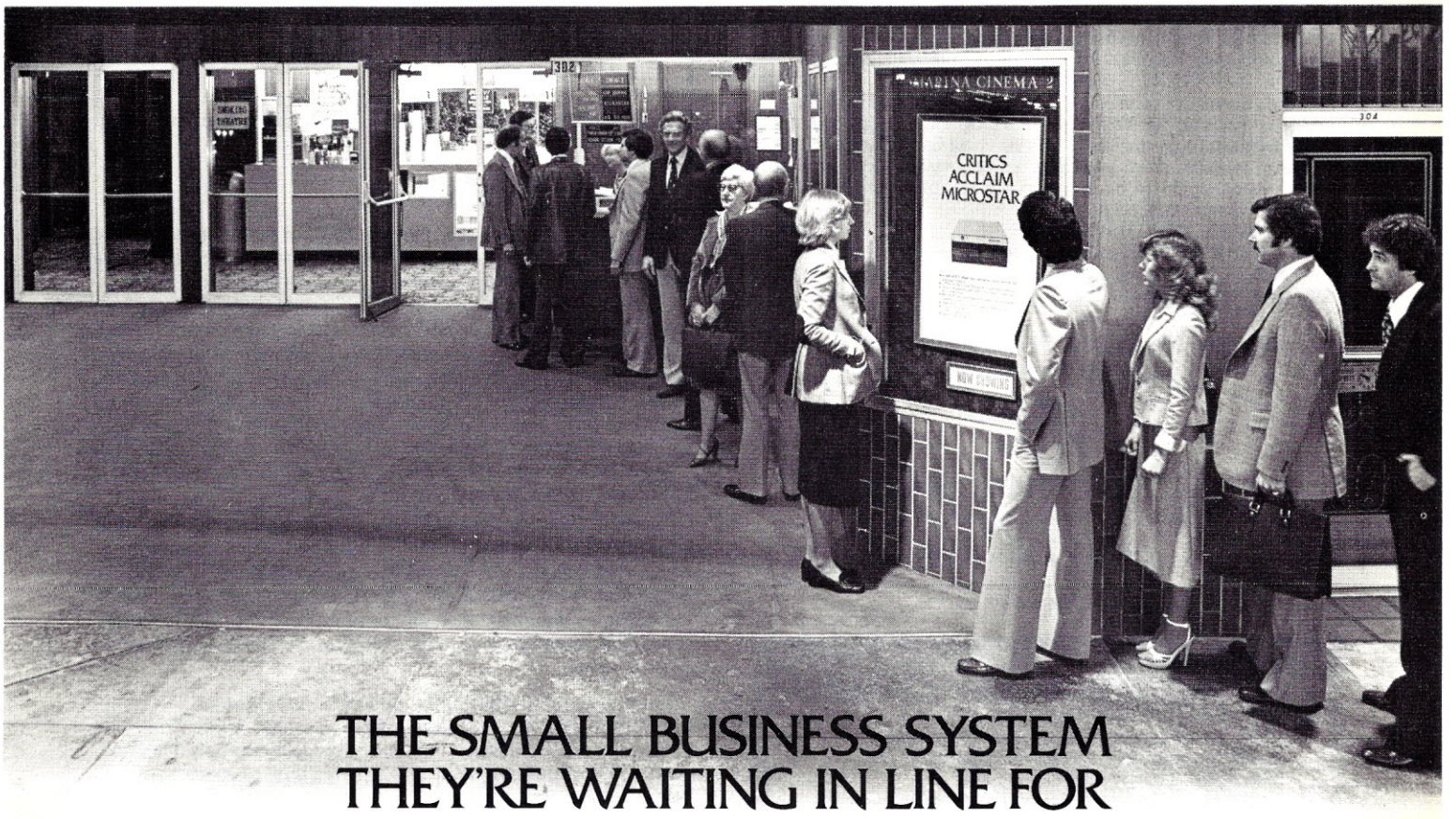
The performance lasted only twenty minutes. As the last note faded, everyone in the audience came to their feet, applauding and cheering. He found it very difficult to understand such emotional displays.

As the curtain lowered slowly, and quiet descended on the empty hall, he could sense the excitement that still remained in the air. He welcomed the dark coolness as the lights went out. But he knew it would not last. Now that he had been such a success, there would be countless people who wanted to see him, and talk to him and the men who had made him what he was.

And what was he? A product of modern technology. That's why he gave this performance. Not just to play music. But to prove what that technology could produce — the most sophisticated computer known to man. He had been created as another step in man's quest to free himself from a mundane and menial world to engage in more philosophical and ethereal pursuits.

Well, it didn't matter to him. They had given him vision with a lens and camera, they had given him hearing with microphones, they had given him speech with synthesizers and speakers, they had given him almost limitless memory so that he could be programmed to do just about everything a man could, even think. But they had not given him emotions, feelings. He would always be content to be just what he was. He considered himself fortunate. After all, what could a computer create to free himself from a mundane and menial world to engage in more philosophical and ethereal pursuits?☐

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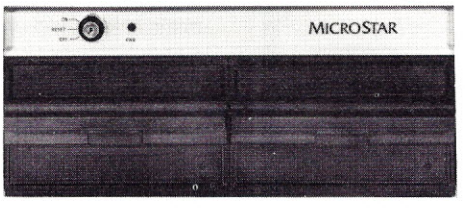



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CIRCLE INQUIRY NO. 47


# R.H.D. real handy data

By Robert H. Distler

## BEGINNING THE PROCESSES

Beginning with this issue, the processes of designing a working database for a specific application will be discussed, and over the next few months a viable application will be developed.

However, in order to develop an application using database concepts, some terms must be understood. The first term is *data managing* or data handling. Data managing is different from data base management, in that this term refers to the actual handling or manipulation of the raw data. For example, you have a mail list made up of a name field, address field, city, state and zip field, and possibly a sort field which can be either the first or last line of the record. Each of these fields is unique in that it requires specific information that is to be handled in a specific manner.

To make this clear, let's deal only with the name field. How long will the field be in actual characters must be the first consideration. Also, what action will take place if the actual entry is shorter or longer than the allowed field length? Here the concept of data handling becomes important. Remember at this point we are only concerned with getting the raw data in and not with saving it on some external media.

For discussion purposes, our name field will allow for 15 characters. This means that if the field entry is less than 15, we either fill it up with special characters or we utilize the leftover space for something else. For our purposes we will fill the unused spaces; so in all cases the name field is always 15 characters in length. Now the decision is what to do is the field entry is greater than 15 characters?

*Field overflow* can be considered a process of error checking; if in fact you decide that it is an error. Since our field is pre-defined at 15 characters, an entry of more than 15 could conceivably cause an error message and force a re-entry of the data. There is an alternative, however; that of automatically truncating — shortening the inputted data to meet the restrictions of the data field. This truncation does have some disadvantages, the most important being that possibly the truncated data will not have the meaning desired by the user. The best alternative, therefore, is to cause a re-entry of the data when the field overflows.

To review: Data management is the actual handling of the raw data, which means making the decisions on the manner in which it will be handled. So far I have discussed only one field of data — name field — and only from the aspect of inputting the data into the computer the first time. This is important to understand, because it is useless to talk about the outputting of data from a database unless it is first built in. During the next several months we will further define each step of data management and the link to developing a database.

The next term that must be defined is *data base management.* You will notice that each time I have used database it has been spelled as one word, and when used with management as two words — data base.[1] The reason is that database refers to the physical media or functional collection data, which is the base that the application words into and out of. On the other hand, data base management refers to manipulation or handling of the collection of data contained within the base.

To put this more in perspective, think of a database as a warehouse — the actual physical media that contains the base of information that will be worked on. The data is obviously the separate and distinct items that the warehouse stores. The data base manager(s) are the warehousemen — they will take some physical action the stored items — data.

Carrying this warehouse idea further, we find that we have a warehouse foreman — he directs the work that will be done and is like the executive of a data base management system. Next we have the router who maintains all records of where each item is stored in the warehouse — he has the keys or index — which is similar to indices maintained in an ISAM — indexed sequential access method of data base management.

Next we have the warehousemen, each assigned to a specific row in the warehouse. Each row contains only a specific type of item, placed on shelves with a part or stock number. The warehouseman is the major key, and the stock number the subkey.

The system would work by the foreman receiving a request for a specific item, then relaying this request to the router, who would in turn check his index of its location. Once the location is established, the router tells the warehouseman in charge of that specific row or key what is wanted by giving him first the main key (which specific warehouseman), then the subkey (the part number). For this discussion, the subkey or stock number specifically pinpoints the exact shelf and location on the shelf of the item.

Now wait. We said that each row contains only specific information or items. This is true. However, within that row are all related items that may differ by only a small amount. Say the request is for green 25 watt light bulbs with a twist base and soft light. Row J has all light bulbs regardless of their shape, wattage or whatever. The same is true for a data item in a database.

Referring back to our mail list, we had several fields: name, address, etc. Within each of these fields are similar data — they are either a name, address, or city, state and zip. But the information contained within these fields differs by actual content (i.e. different names). With this explanation, you can hopefully see how the warehouse concept works for understanding data base management.

## SOME MORE TERMS

To fully appreciate data management, and data base management in light of our development of a mail list over the next few months, some other terms are important.

*Volume.* This refers to a single unit of external storage, which is read from or written to by a single storage device, (i.e. disk drive). For the purposes of our mail list, we will use a two-disk volume. Disk zero contains the driving programs and database indices, and disk one the actual database. For practical purposes, the actual database can extend over more than one physical disk but is considered part of the same volume, because all the data is interrelated.

*File.* This is a collection of related data, all treated as a unit. For our purposes the file will also equal the volume, although it is possible to have several files in one volume.

*Record.* The primary content of a file that contains specific data related to the file structure. A record is made up of fields of variable or fixed length that can be treated as subfields.

*Hashing.* This is a method of determining the location of a data item by going from index to actual address or location.[2]

Next month I will begin defining the design of the mail list database, and over the course of the next few months discuss the methods of data management/handling and the data base management system as it is being developed.□

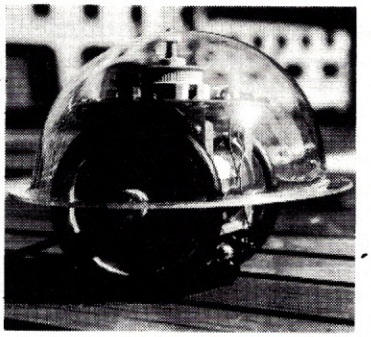
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[1]There are several thoughts on how data base or database should be spelled. Some authors use data-base or data base to refer to several 'stores' of data. The terms, as used in this article — database and data base management — are, we believe, the most correct and present the greatest clarity to the subject.

[2]Hashing is a technique that has several definitions. The technique offers several advantages and disadvantages and must be defined precisely to how the system will work. Although the definition offered at this point is not complete, it is sufficient for our purposes.

*Do you have a specific question regarding data handling, or data base management? Then write to R.H.D. care of Robert H. Distler, P.O. Box 6376, Oxnard, CA 93031, or call (805) 487-7422.*


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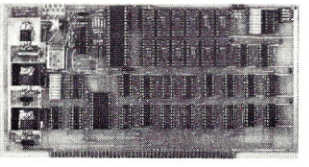
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CIRCLE INQUIRY NO. 8

# UPDATE

### CALL FOR PAPERS FROM IEEE

A call for papers has been issued for a special issue of IEEE Transactions on Machine Intelligence and Pattern Analysis. This special issue will be published in July, 1980. It is being sponsored by the Biomedical Pattern Recognition Sub-Committee of the IEEE Computer Society Technical Committee on Machine Intelligence and Pattern Analysis, and co-sponsored by the IEEE Engineering in Medicine and Biology Society.

The scope of the subject matter for this special issue includes computer-aided analysis of radiographs, chromosomes, blood cells, Papanicolaou smears, computed tomograms, etc. Papers for consideration in this special issue should be submitted by July 1, 1979, to:

Dr. Jack Sklansky, School of Engineering
University of California
Irvine, CA 92717
(714) 833-6726

Transactions on Pattern Analysis and Machine Intelligence is published quarterly, starting January, 1979. For subscription information write to PAMI, P.O. Box 639, Silver Spring, MD 20901.

### APPLE CLUB FORMS IN RALEIGH

A new Apple computer club has been founded in the Durham-Raleigh-Chapel Hill (Research Triangle) area.

The club meets monthly on the third Tuesday at different locations. Annual dues are $5, with a monthly newsletter and software library developing. At least two Apple computers with dual disk drives will be attendant at each meeting. For more information contact Felix Clayton (919) 596-8970 or Gene Jackson (919) 781-3755.

### INTEL CUTS 8086 PRICES

Microcomputer Components Division has announced price reductions of 23% and 21% respectively for the 5mHz and 4mHz versions of its 16-bit 8086 microprocessor.

Intel expects that the 8086 will move down the price/learning curve as fast as did Intel's industry standard 8080 microcomputer. The reasons given for this are the use of the HMOS process to produce the 8086 and the rapid customer acceptance of the new 16-bit microcomputer.

### CHANGE OF ADDRESS

The San Diego Computer Society has changed the location of its meeting and mailing address.

The club meets the third Saturday of each month at the County Education Center, 6401 Linda Vista Rd. at 12:30 p.m. For details write P.O. Box 81537, San Diego, CA 92138 or call (714) 566-2839.

### CLEVELAND GROUPS MERGE

The Cleveland Digital Group and the TRS-80 User's Group have merged. For information about the group's many meetings, contact John Kane at the Euclid Square Mall Radio Shack or phone the 7 C's at (216) 361-3100.

### BUSINESS GROUP FORMS

A Microcomputer Business Users Group meets monthly in New York to discuss application software, system software and hardware. Meetings are the first Tuesday of each month. For information contact the group at MBS, 161 West 75 St., New York, NY 10023, (212) 580-3589 on weekends.

### BUBBLE MEMORY MARKET SUCCESS PRICE RELATED

According to a Venture Development Corporation study, the price of bubble memory will be the key question that will determine the success of the magnetic domain (bubble) memory.

The VDC report predicts that the bubble industry's most rapid growth period will occur in 1980 when the total market will increase from $11 in 1979 to $58 million in 1980. By 1983, sales are forecast at $231 million. The forecast has been based on VDC's estimate of the probable price/performance improvement.

For more information on the *Bubble Domain Memory Markets,* please contact Edward Ross, Senior Consultant at Venture Development Corp., One Washington St., Wellesley, MA 02181, (617) 237-5080.

### MECA EXCHANGE LIBRARY

A Meca Exchange Library has been organized to aid in the exchange of software. Persons contributing a program receive one program at no charge other than duplication, media and postage expenses. About 100 programs are now available.

Persons who want to join should send 25¢ for a list of available programs or contribute a program for credit and a free list. Send replies to the library in care of Angel Gomez, 17 Rumson Rd., Kendall Park, NJ 08824.

### SUPERVISION FACILITY FOR COMPUTER TIME-SHARING

A computer peripheral designed by an Australian firm, Computer and Data Services of Australia Pty Ltd., provides full supervision facilities for time-sharing systems normally only available on large mainframe computers. The company is currently seeking agents in the U.S.

The "CDSA Line Supervisor" is an intelligent peripheral, based on a Zilog Z-80 microprocessor, and provides facilities which usually require complex software.

For information contact the Australian Government Trade Commission, 636 Fifth Ave., New York, NY 10020.

### TRS-80 NEWSLETTER

TRS-80 Club of Arlington (MA) is offering a free newsletter to those who send a long, stamped, self-addressed envelope. The April issue features word processing and business software. A 50¢ donation will be appreciated but is not required. TRS-80 vendors please send full product description and $20 to share printing costs. Write to TRS-80 Newsletter, 96 Dothan St., Arlington, MA 02174.

## COMING IN JUNE

Beginning in June, INTERFACE AGE will start a tutorial to explain one of the most powerful new computer languages, PASCAL. Associate Editor Henry Davis will be explaining the basics of PASCAL, detailing the commands, code words and many other aspects of the language.

The PASCAL Notebook will include a complete compiler based on P-4 implementation, the last implementation written by Niklaus Wirth, the designer of the language. The P-4 is in the same line as the widely-known UCSD compiler.

Not only will the series detail some of the finer points of the language and the steps necessary for implementation, but it will also explain the reasoning behind their implementation. By explaining the theory that formed the basis of the language, Davis will give the reader an understanding of all languages. By the end of the tutorial, serious readers will be able to write their own language.

The PASCAL Notebook will be of interest to all those who are interested in language design or who simply want to learn how to use PASCAL.

Let INTERFACE AGE be your guidebook for this exciting language. Watch for the PASCAL Notebook, beginning in June.

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**LINK-80** Loads your relocatable assembly language modules for execution and automatically resolves external references between modules.

**CREF-80** Gives you a complete dictionary of program symbols, showing where each is defined and referenced.

The Microsoft TRS-80 FORTRAN Package is still available for $350. Or, for HALF PRICE, get the TRS-80 ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM.

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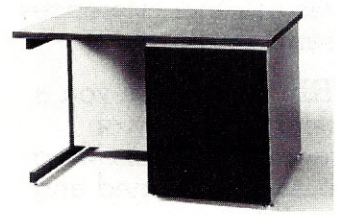
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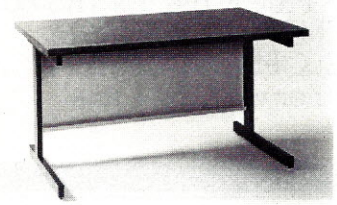
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## AMPEX LAUNCHES BUSINESS PRODUCTS DISTRIBUTOR PROGRAM

Ampex Corporation has announced a new distributor incentive program to better serve the growing market for its magnetic media business products.

The program, which applies to the full business product line — flexible disks, magnetic cards, data and voice cassettes, and mini/micro cassettes — is an extension of the distributor incentive program Ampex introduced last year for industrial audio and video tape products.

The business products line was first introduced last March and since then has been exhibited at all major trade shows. Ampex will add OEM-qualified double-sided, double-density (2-D) flexible disks to the product line in the near future.

Complete program details and additional information are available from Richard A. Antonio, national sales manager-industrial products, Magnetic Tape Division, Ampex Corp., 401 Broadway, Redwood City, CA 94063, (415) 367-3809.

## GLITCH KICKERS COMPUTER CLUB

The club has recently formed and is looking for new members. It is open to anyone, whether they have a computer or are just interested in learning about computers. They are going to work in several areas, including education, writing software, and starting a personal computer network.

The club meets the first and third Saturdays of each month at 2 P.M. at The Computer Emporium, 3711 Douglas, Des Moines, IA 50310. For information call 279-8861.

## USSR USING CADO SYSTEMS

The Soviet Union General Technical Department (GKES) is using Cado Systems Corporation's System 20 small business system to perform the data processing in its economic support of underdeveloped nations.

The Torrance, California, company shipped eleven of its System 20 computers to the Soviet Union last summer and the GKES has been programming them for the foreign aid application.

While the first Russian usage of Cado Systems is for the Soviet foreign aid program, the Russians plan to use additional System 20s for such applications as automatic invoicing, payroll, stock control, and statistics, a Cado spokesman said.

## HELP AVAILABLE TO FIRMS DAMAGED BY IMPORTS

Any firm that has been damaged by imports, or that is in danger of being damaged by imports, can find help through a new Trade Adjustment Assistance Center (TAAC) established at the University of Southern California by the Economic Development Administration (EDA) of the U.S. Department of Commerce.

Firms that have suffered declining sales, losses in production or employee lay-offs because of imports can call on TAAC's full-time staff of management and technical specialists, plus a wide range of multi-disciplined consulting experts available to TAAC, to solve specific company problems. Three levels of technical assistance are available from TAAC to trade-impacted firms.

Any firm that feels it has been actually damaged, or is in danger of being damaged, by imports is eligible to apply for technical and financial assistance provided by the Trade Adjustment Assistance Program.

Trade-impacted firms in the Western Region seeking help should contact the Trade Adjustment Assistance Center, University of Southern California, University Park, Los Angeles, CA 90007, (213) 741-8427.

## TRS-80 CLUB FORMS IN DAYTON

The Dayton Area TRS-80 Users Group is being organized. Anyone is welcome, whether they own a TRS-80 or not, Level I or Level II.

For more information contact Dennis E. Recob, 231 Green St., Dayton, OH 45402, (513) 222-3504.

## VALLEY CLUB MOVES

The Valley Computer Club — now with 228 members — is no longer meeting at the Harvard School in Studio City. The club now meets at the Burbank Board of Realtors Hall at 2006 W. Magnolia Blvd., Burbank, California.

The time remains the first Wednesday of each month at 7 p.m. Inquiries should be made to The Valley Computer Club, P.O. Box 6545, Burbank, CA 91510.

## MSU COMPUTER TALKS TO OTHER UNIVERSITY COMPUTERS

Since the early 19702 the Merit Computer Network has allowed Michigan State University computer users to communicate with and receive data from computers at the University of Michigan and Wayne State University.

Plans are now completed to link in Western Michigan University to the network, and future plans allow for access to the system for other public institutions in Michigan.

Supplementing the Merit system, and recently linked to it is the Telenet Computer Network which allows access from university and college computers around the United States and in Canada.

Computer users at MSU, with proper credentials, account numbers and passwords, can gain access to the Merit system by telephone or by use of any of the 350-odd terminals linked to the CDC 6500 computer on the campus.

The Telenet Computer Network allows computer access from 82 locations in 33 states including Hawaii and the District of Columbia and another array of "ports" across Canada.


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Explains computers, programming, hardware, BASIC, FORTRAN & COBOL languages, advanced concepts & computer center operation. 320 pgs. *#21534 . . . $9.95.*

**The 8080A Bugbook®: Microcomputer Interfacing and Programming**
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Covers basic gates thru microcomputer interrupts, with hardware & software examples. Experiments re: breadboarding, circuits, etc. over 416 pgs. each. Book 1: *#21550 . . . $12.95.* Book 2: *#21551 . . . $10.95.* Both: *#21552 . . . $20.95*

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**NCR Data Processing Concepts Course**
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**Understanding CMOS Integrated Circuits (2nd Ed.)**
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# CALENDAR

## TWO DATA ENTRY COURSES

Management Information Corporation is sponsoring two interactive seminars that deal with data entry. Discussions with instructors and other participants will provide solutions to problems that can be easily implemented.

"Data Entry Management and Supervision Seminar" includes instruction in data entry system concepts, organization of the data entry department, data entry control techniques and operator training.

MIC is holding the course at the Cherry Hill Inn in Cherry Hill, New Jersey on April 2-4 and June 18-20.

The other course is entitled "The Data Entry Operator." The objective of this two-day interactive seminar is to make the data entry operators aware of their capabilities and motivate themselves towards reaching their own pre-set goals.

The seminar will also be held at the Cherry Hill Inn on May 22-23, 1979.

For registration fees and more information contact Management Information Corp., 140 Barclay Center, Cherry Hill, NJ 08034, (609) 428-1020.

## SYMPOSIUM ON SPECIFICATIONS OF RELIABLE SOFTWARE

The Symposium on Specifications of Reliable Software will be held April 3-5, 1979 in Cambridge, Massachusetts.

The invited talks by leading experts, the contributed papers and panels, in the Program Committee's opinion, represent the current state of the art in system specification. They have also included users and developers of all generally available system specification methodologies. The conference topics range from system requirements to verification of system specifications.

For more information call Dr. Marvin V. Zelkowitz at (301) 439-7007.

## EDP TREND BRIEFING SESSIONS

The 1979 Caravan group of Computer Expos will bring together leading vendors of DBMS and programmer productivity software onto special panels during the Computer Expo EDP Trend Briefing Sessions.

The schedule of Computer Expos is as follows:

Twin Cities Computer Expo
St. Paul, April 3-5
Northwest Computer Expo
San Francisco, April 17-19
Southern California Computer Expo
Los Angeles, April 24-27
Southwest Computer Expo
Houston, May 8-10
Southeastern Computer Expo
Charlotte, May 15-17
Northeastern Computer Expo
Pittsburgh, May 22-25
New England Computer Expo
Boston, May 29-31

Information is available from The Caravan Group, 60 Austin St., Newtonville, MA 02160, (800) 225-4260.

## TWO-DAY MANAGEMENT SEMINAR

The cash impact of manufacturing decisions is the focus of "Effective Production Planning and Inventory Management," a seminar presented by the Wharton School of the University of Pennsylvania on April 16-17 in Toronto, May 14-15 in San Francisco and June 25-26 in Chicago.

Designed for manufacturing organization executives, the seminar presents techniques to increase working capital, reduce inventories without compromising service, forecast market demands, resolve potential problems and minimize shortages and production delays.

For information contact Heidi E. Kaplan, Dept. 20 NR, New York Management Center, 360 Lexington Ave., New York, NY 10017, (212) 953-7262.

## PASCAL PROGRAMMING WORKSHOP

Polytechnic Institute of New York and the Institute for Advanced Professional Studies are presenting a five-day intensive seminar for engineers, programmers and technical managers. The seminar is titled "PASCAL Programming for Mini and Microcomputers."

The seminar will be held April 23 through April 27 at The Ramada Inn, Woburn, Massachusetts. For additional information contact Professor Donald D. French at (617) 964-1412 or the Institute for Advanced Professional Studies, One Gateway Center, Newton, MA 02158.

## ELECTRO/79

Electronics in the opening years of the 1980's and their expected impact on industry and individuals will be the focus of Electro/79 in New York April 24-26. The high-technology show and convention, including three days of exhibits and technical presentations preceded by a day-long marketing seminar, will be staged at the New York Coliseum and the Americana Hotel.

Keynote speaker for Electro will be Charles L. Brown, Chairman of the Board and Chief Executive Officer of American Telephone & Telegraph Company. Brown will address a luncheon at the Americana on April 23.

Direct registration at the door is accomplished through issuance of a "credit card" type inquiry badge. Price is $5 per person.

## ICS OFFERS COURSES

Integrated Computer Systems, Inc. is offering 10 courses in a variety of cities in the U.S. and Canada. Classes run from one to five days.

*Structured Programming* will be held in Detroit, May 1-4; Washington, D.C., May 15-18; Chicago, June 5-8; Toronto, June 12-15; Hartford, June 19-22; and in San Francisco, Minneapolis and Ottawa in July.

The *Database Management Systems* course runs from May 8-11 in Washington, D.C.; May 15-18 in Los Angeles; July 10-13 in Toronto; July 31-August 3 in San Francisco and August 7-10 in Minneapolis.

*Distributed Processing and Computer Networks* will be held in Detroit, April 24-27; St. Louis, May 1-4; San Francisco, May 8-11; Chicago, May 15-18; Toronto, June 5-8; Hartford, June 12-15; Washington, D.C., June 19-22; San Diego, July 10-13; Ottawa, July 17-20; and in Minneapolis, July 24-27.

A course in *Computer Graphics* will be held in Boston, April 24-27; Philadelphia, May 1-4; San Francisco, May 8-11; Seattle, May 15-18; St. Louis, June 5-8; Toronto, June 12-15; and in San Diego, Washington, D.C., Ottawa and Minneapolis in July.

*Small Computing Systems* will be held May 2-4 in Los Angeles; May 9-11 in Washington, D.C.; May 16-18 in Boston; June 6-8 in Toronto; July 25-27 in San Diego and August 1-3 in Ottawa.

Other courses available through the spring and summer months include *Troubleshooting Microprocessor-Based Systems, Modern Methods of Digital Signal Processing, Spread Spectrum Communication Systems, Microprocessor Hands-On Workshop* and *Military and Aerospace Microprocessor Systems.*

For information about the courses, contact ICS at 3304 Pico Blvd., P.O. Box 5339, Santa Monica, CA 90405, (213) 450-2060 or at 300 N. Washington St., Suite 103, Alexandria, VA 22314, (703) 548-1333.

## SOFTWARE ENGINEERING TECHNOLOGY SEMINARS

Software Research Associates has scheduled Professional Development Seminars on seven topics in Software Engineering to be presented during March through June 1979 in San Francisco. The series is intended for both management and technical personnel involved in all phases of Software Engineering.

The series brings together a group of technical specialists in a uniform presentation format designed to answer deep technological questions of importance in contemporary system design and implementation. Additional presentations are planned for the Washington, D.C. area in the Fall, and Europe in 1980. Seminars included are:

*Software Testing Technology* (26-27 April 1979, $425) by Edward Miller, describing modern methods for effectively assuring the quality of software.

*Performance Enhancement Technology* (17-18 May 1979, $425) by Domenico Ferrari, which focuses on techniques for increasing the performance of software systems.

*Modern Software Engineering Tool Technology* (24-25 May 1979, $425) by Edward Miller, surveying available software tools that can be used effectively in all phases of a software system's life cycle.

*Software Metrics Technology* (31 May-1 June 1979, $425) by Tom Gilb, which focuses on the new methods of measuring and quantifying software systems.

*Software Reliability Technology* (21-22 June 1979, $425) by Herbert Hecht, intended to address contemporary methods for assessing the actual reliability of any software system that is used in a critical situation.

*Software Costing Methods* (28-29 June 1979, $425) by Victor Schneider, an in-depth investigation into the latest technology for estimating costs associated with software design, development, testing and maintenance.

Registrations details are available from Software Research Associates, P.O. Box 2432, San Francisco, CA 94126, (415) 957-1441, Mrs. Jill Engelbrecht.

## OFFICE TECHNOLOGY RESEARCH GROUP SETS SPRING MEETING

The Spring Meeting of the Office Technology Research Group will be held at the Hotel Del Coronado in San Diego, California from April 30 to May 2.

The Group is an international association of administrative executives interested in staying abreast of and planning for the use of Office of the Future technologies in their operations.

For additional information about the Group write on company stationery to Mr. John J. Connell, Executive Director, Office Technology Research Group, Box 65, Pasadena, CA 91102.

## TELECOMMUNICATIONS SEMINAR

A seminar program, Telecommunications: Trends and Directions, designed to provide an in-depth briefing on the status of the telecommunications industry for members of the financial community has been scheduled for May 22-24 at Dunfey's Hyannis Resort at Hyannis, Massachusetts.

The Hyannis Seminar is sponsored by the Communications Division of the Electronic Industries Association. The purpose of the meeting is to bring in top level executives from the telecommunications industry for frank and open discussions describing the present status and future direction of their segment of this fast-changing industry.

Information regarding registration may be obtained from Peter Bennett or Karen Settevig at (202) 457-4937.

## CONFERENCE AND EXHIBIT ON SMALL COMPUTERS

The Clemson Conference on Small Computers, "Application for Business, Industry, Education, Medicine" will be held at Clemson University on May 23-24. The conference will interest those who have become interested in small computers but who have a wait-and-see attitude, as well as persons who are already involved with small systems. Applications to be discussed are business, industry, engineering, medicine, education, agriculture and even the home.

For registration information contact Continuing Engineering Education, Clemson University, Clemson, SC 29631. For details on applications to be discussed or equipment exhibits contact W.J. Barnett, Electrical & Computer Engineering Dept.

## IEEE CHICAGO CONFERENCE ON CONSUMER ELECTRONICS

A special session on Teletext, Viewdata, and related Text-on-Television subjects is being organized for the 1979 Chicago Spring Conference on Consumer Electronics, which will take place on June 4 and 5 at the Arlington Park Hilton Hotel near Chicago's O'Hare Airport.

For information contact session organizer Dr. Walter S. Ciciora at (312) 391-8431.

## NATIONAL SOFTWARE SHOW

Lee B. Mulder, president of Software Exhibitors, Ltd. announced that plans have been finalized for a national show called The Software Supermarket to be held in New York City on June 4-7, the same time as the National Computer Conference (NCC).

The show is at the Hotel Taft. For more information contact Lee Mulder, (312) 529-3518.

## ELECTRONICS PRODUCTION ENGINEERING SHOW

An international industrial exposition devoted to the needs of the manufacturers of electronic products in Korea has been announced by Clapp & Poliak, Inc., New York.

The exhibition, to be known as the Electronics Production Engineering Show, will take place this year at the Kosami Exhibition Center, in Seoul, November 5-8, and will be accompanied by an international conference with speakers drawn from the United States, Japan and Western Europe.

Further information is available from Expoconsul, the Clapp & Poliak international sales division, 420 Lexington Ave., New York, NY 10017.


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**Memory Test $14.95**
For Level II computers, 4K to 48K. Test ROM, RAM and video RAM.

**Object Code Relocator $15.95**
Designed to relocate machine language programs that were written too far down in memory to be used with Radio Shack's disk drive system. This program permanently moves most of Radio Shack's machine language programs into higher area of memory, thus enabling the program to reside in memory along with DOS and DISK BASIC. The user does not have to reload the relocated program each time it is used as it can be permanently moved high enough to escape the disk system.

**16K Star Trek $10.95**
A real-time Star Trek game for the TRS-80 written in machine language. Long range sensors display the Enterprise's position and objects in its adjacent quadrant at all times. Offers several features never incorporated in Star Trek games before.

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## METRIC STANDARDS STRATEGY MEETING SCHEDULED

Developing a strategy for preparing sound metric standards and implementing them is the subject of a seminar to be held June 4-5 at the Sheraton O'Hare Motor Hotel in Chicago. The American National Standards Institute, which coordinates the development of voluntary national standards in the United States, is sponsoring the meeting.

Registration information for the seminar on "Developing the U.S. Metric Standards Strategy" is available from Claude H. Burns, deputy managing director, American National Standards Institute, 1430 Broadway, New York, NY 10018.

## CONFERENCES ON COMPUTERS AND THE HUMANITIES

Two major international conferences are scheduled at Dartmouth College in 1979. The Fourth International Conference on Computers and the Humanities (ICCH/4) will be held August 20-23. The Conference on Data Bases in the Humanities and Social Sciences will follow on August 24-25.

ICCH/4 is the latest in a series held previously at the Universities of Minnesota, Southern California, and Waterloo, Ontario. It is sponsored by the Association for Computers and the Humanities.

There will be papers on the application of computers to research in language, literature, musicology, history, archaeology, and other related disciplines. Selected papers will be printed in "Computers and the Humanities."

Further information is available from Professor Joseph Raben, Queens College, Flushing, NY 11367, (212) 520-7407, 520-7428.

## CALL FOR COMPUTER MUSICIANS

Due to the tremendous success of last year's computer music concert during the PC '78 show, the Philadelphia Area Computer Society is planning a full day conference on computer music which will include tutorials, demonstrations, product reviews, workshops, and seminars.

The conference will be held during one day of the PC '79 show in Philadelphia in October. The conference will be followed by the evening concert of computer music, to be held in a large auditorium nearby at the University of Pennsylvania. A professional recording will be made as it was last year.

If you are interested in participating in the concert or conference or would like a recording of last year's concert, write to: Computer Music Conference, Philadelphia Area Computer Society, Box 1954, Philadelphia, PA 19105.

## ACM '79

The ACM 1979 Annual Conference will be held at the Plaza Hotel in Detroit, Michigan, October 29-31. The theme, "Advances of the 70's — Challenges of the 80's," focuses on the advances of the state of the art of computing during the past decade, the challenges that face computing in the next decade, and the transfer of computer technology from today's research to tomorrow's practice.

For more information contact Mayford L. Roark, Ford Motor Company, The American Road, Room 895 WHQ, Dearborn, MI 48121, (313) 323-1690.

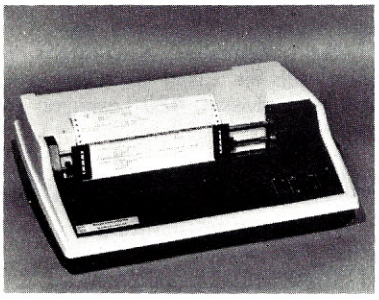
## COMPUTER GRAPHICS WEEK

Computer mapping and related software, hardware and data bases will be the subjects of a week-long international users' conference July 15-20, sponsored by the Harvard University Laboratory for Computer Graphics and Spatial Analysis.

Called Harvard Computer Graphics Week '79, the conference will be held in Cambridge, Massachusetts. The focus of this year's conference will be currently available cartographic and statistical data bases, graphics hardware, software, and the electronic communication of geographical information.

For details, contact Kathleen Quigley, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5035.


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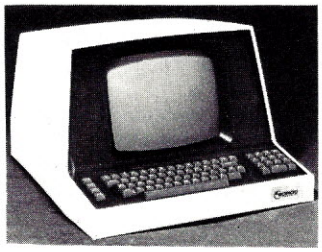


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## CHORAFAS SEMINAR

"Distributed Information Systems" will be the topic of two identical seminars scheduled for June, 1979 by Dr. Dimitris N. Chorafas, internationally-known management and data processing consultant.

The first will be held June 11-15 at the Radisson-Chicago Hotel, Chicago; the second June 18-22 at the Breckenridge Pavilion Hotel, St. Louis.

Topics will include new communications technologies; use of protocols and data bases; new software developments and applications.

Dr. Chorafas has operated a consulting business since 1961, advising company presidents, conducting seminars, and executive development programs for the American Management Association; IBM; Olivetti; Honeywell; General Electric; Shell Oil; ITT, UNIVAC and others.

For more information contact Richard A. Laubhan, Project Communications Inc., 333 E. Ontario, Suite 2603B, Chicago, IL 60611, (312) 266-2113.

## INTRODUCTION TO DIGITAL ELECTRONICS AND MICROCOMPUTER INTERFACING

This two week short course will be held July 16-27. It is a hands-on laboratory course for academic and industrial personnel. There will be one microcomputer laboratory station for each two participants. The course entails approximately 60 hours of laboratory instruction.

Reasonable living accommodations including free camping facilities. Tuition is $395. Academic credit is available.

For more information and application forms contact Professor Philip Peters, Department of Physics, Virginia Military Institute, Lexington, VA 24450.

## UPCOMING SHOWS

Electronic Conventions, Inc. plans these 4-day shows:

Wescon/79 Show and Convention will be held September 18-20 at Brooks Hall and the St. Francis Hotel in San Francisco.

Midcon/79 Show and Convention will be held at O'Hare Exposition Center and the Hyatt Regency O'Hare on November 6-8.

For more information contact Electronic Conventions, Inc., 999 No. Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

## AUSTRALIAN COMPUTER SHOW

Melbourne's first home computer show will be held December 9-10 at the Box Hill Town Hall on Whitehorse Road, Box Hill.

The show will be open from 10 a.m. to 10 p.m. December 9 and 10 a.m. to 6 p.m. December 10.

The admission fee is $2. For more information contact Australian Seminar Services Pty. Ltd., telephone (03) 267 4311.

## Information Requested

Organizations sponsoring shows, seminars and classes concerning computers, business and related topics are requested to send information to Terry Costlow, INTERFACE AGE, 16704 Marquardt Ave., Cerritos, CA 90701. Press releases should be typed and double spaced, preferably not exceeding one page, except for multiple listings. Please send the information at least three months before the show date.


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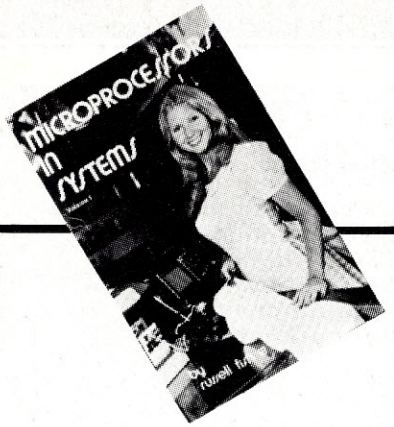
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**CIRCLE INQUIRY NO. 55**

# FROM THE FOUNTAINHEAD

By Adam Osborne

It is time to review, once again, the availability of new microprocessor chips.

At long last, Motorola has a few 6801 one chip microcomputers available. (I remember the conviction with which Motorola representatives assured me the 6801 would be available by April of 1978.) The 6809 is still not available; I doubt if any significant number of 6809s will be available before late 1979. As for Motorola's 68000, their contribution to the 16-bit microprocessor race, I predict it will be 1981 before the 68000 is generally available. (I bet that prediction will generate a letter to the editor.)

Zilog's Z8 one-chip microcomputer is also available — finally. The 6801 and the Z8 both are very interesting parts. Unlike early one chip microcomputers, these late entries have the processing power of typical mainstream 8-bit microprocessors, together with a wide variety of configuration options. Parts like the Z8 and the 6801 will likely become the building blocks for a wide variety of future intelligent logic applications. These parts are not likely to find their way into personal or business computers; they have little to offer over the old standby 8080, 6800, Z80, 6502-based products; and they certainly cannot compete with the 16-bit microprocessors which will dominate the next generation of business computers.

Intel will soon have a low cost, 8-bit version of their 16-bit 8086 available. This 8-bit version will have the 8086 instruction set, but it will use an 8-bit Data bus. You can expect to see this part in mid-1979.

My rule of thumb is to add between 18 and 24 months to any first announced delivery date for a Motorola microprocessor part. I add between 12 months and 18 months to any initially announced Zilog date. Intel has recently tried very hard to be accurate in its delivery date predictions — and it is beginning to succeed.

Believe it or not, a strong **personal and home computer market** is beginning to emerge under the noses of all of us who have assumed that the entire microcomputer market belongs to business systems. Apple Computer Corporation has long stressed this segment of the market; it quickly got competition from Exidy. Bemused Commodore and Radio Shack sell the PET and TRS-80, respectively, to the most bewildering and undefinable mass of customers. Now, Atari, the king of the TV games, is making a concerted push into the home and personal computing markets.

The home and personal computer industries are likely to trigger the first significant divergence between European and U.S. microcomputer industries. Up till now, it has been possible to track the emerging European microcomputer industry and plot its progress 18 months to two years behind the U.S.A. In particular, I receive a number of British microcomputer club newsletters, which show a surprising parallel to what went on in California two years ago. But that is all due for a big change; and Europe may soon pull ahead of the U.S.A. in the important segment of home and personal computers. This is because Britain already has Teletext, France has its equivalent, and the rest of Europe is buying one system or the other. The U.S.A. has nothing like them, and will not have for the next five years.

Computer retailers would do well to check on the **laws covering electrical product** safety and how they apply to the microcomputer equipment now being sold out of computer stores. Recently, the City of Los Angeles has started cracking down on computer stores, claiming that microcomputer hardware must be listed by Underwriters Laboratories or the City of Los Angeles' equivalent. There is a bewildering profusion of regulations covering safety and engineering standards for any electrical equipment that is sold into the home — as many microcomputers are today.

Technically, many computer stores in this country are operating in gross violation of the law and could be shut down. Hopefully, no legal authority would resort to such Draconian measures; instead they might give stores a chance to come into compliance.

Larry Grimes of Professional Systems Development, Inc. sent me a very impressive set of documentation for his new accounting software application package named ASAP. I can make no comment on its availability, or how error-free it is, since I have not talked to any users; but the documentation is certainly thorough, and the package appears to be very complete. Professional Systems Development, Inc. can be contacted at:

255 East Chapman, Suite 411
Fullerton, CA 92631

For those of you who think that you have seen all the shows, you have seen nothing until you visit a **Computer Electronics Show.** I did, in Las Vegas in January, and I was deeply impressed. Just the computer and semiconductor related area of the show was bigger than any computer fair I have seen, while some of the large manufacturers' pavilions could accommodate an entire computer fair. It is easy to lose perspective of the fact that microcomputers are just one small part of a burgeoning electronics industry. The Consumer Electronics Show provides this perspective in a very educational way. The next Consumer Electronics Show is in Chicago, unfortunately from June 3rd through June 6th. This overlaps the National Computer Conference. But then, the overlap may not be so unfortunate for visitors traveling to one show who might easily extend their trip to take in the other show. For information on the June Computer Electronics Show:

Consumer Electronics Show
Two Illinois Center, Suite 1607
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The Electric Pencil combines features found in more expensive systems with many capabilities you won't find anywhere. Right margin justification, page numbering and titling, and many combinations of line length, page length, and line and page spacing are always under your control. Text editing capabilities eliminate guesswork when inputting. The text appears on the video monitor as you insert it, and you can view text whenever you wish using the bidirectional variable speed scrolling feature. You can insert, delete, or relocate any text using simple keyboard commands.

The Electric Pencil has been designed to work with both Level I (16K system) and Level II models of the TRS-80, and with virtually any printer you choose. Level II owners will want the TRS-80 disk version, which is supplied on cassette. Transfer of the Electric Pencil to your own disk is as simple as entering a command.

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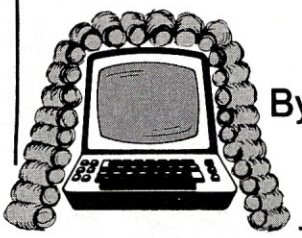
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CIRCLE INQUIRY NO. 44


# JURISPRUDENT COMPUTERIST



By Elliott MacLennan
Attorney-at-Law

## CONTRACTS

A contract, for our purposes, establishes a legally enforceable relationship between the parties involved. It "freezes the market" with respect to the goods or services being bought and sold by defining who is to do what, when, for how much, and tells what happens when problems arise.

The sale of software packages represents a relatively new addition to the microcomputer marketplace. The newness alone is not responsible for certain unresolved traps for the unwary seller and purchaser. Instead, its uniqueness as a product causes the problems. It has not been resolved whether software is a tangible good or an intangible service; a service because it involves ideas, methods and processes, or a good because it is recorded on paper, disks or tape.

**It has not been resolved whether software is a tangible good or an intangible service. For this sole reason, software package contracts must be clearly drawn.**

The problem manifests itself in a practical if not painful way. Namely, the Uniform Commercial Code adopted in all states except Louisiana, which serves as a stable and predictable business benchmark to both vendors and consumers, has not yet been interpreted to either include or exclude software items. For this sole reason, software package contracts must be clearly drawn. If not, both vendor and purchaser face a morass of expensive litigation with uncertain results.

There are four major risks to both vendor and purchaser in software packages.

### Nonperformance

The package does not meet its specifications, fails to perform effectively, uses more hardware or yields results other than those expected. These are a few nonperformance problems.

If these difficulties arise, the contract should provide for termination. Critical to the vendor is the amount of money to be refunded if the acceptance failure occurs during the warranty period.

### Cost of Modification

A payroll package may need adaption to take care of a change in local tax rates. Such modifications can be quite costly and sometimes difficult to integrate into an unfamiliar package. The contract should provide for assistance with such modification at a specified rate.

### Bankruptcy of the Vendor

The undercapitalization of some independent software houses raises the unfortunate spectre of business closings. The contract

should provide some language enabling the user to continue to own, modify and maintain the package without penalties.

### Infringement

It is sometimes difficult to trace the ownership of software. Accordingly, some ownership guarantee has to be given and a comprehensive infringement indemnification should be provided to the user. An indemnification provision alone will not suffice. A provision for attorney's fees in favor of the user should be inserted in the contract. It is useless to have a right to remedy without being able to afford an advocate for that remedy. The remedy itself, financial damages, is questionable with an undercapitalized user. The vendor should make some serious attempt to have his counsel limit his financial responsibility for infringement. Some insurance companies have developed a coverage that will pay all sums the insured is obligated to pay for damages.

## GROUPINGS OF SOFTWARE PACKAGES

The four major groupings of a software package contract are performance, financial, installation support and warranties. Performance will be discussed this month, with the others to be presented later.

### Documentation

The total documentation to be supplied by the vendor must be defined so that the user can perform the acceptance tests on both the package and the software.

### Future Documentation

The contract should specify that the vendor is required to make improved versions of the documentation available to the customer as they become available.

### Documentation Reproduction

Reproduction of copyrighted documentation is prohibited, although it is reasonable for the user to be able to copy it for internal use. It is also reasonable for the vendor to request control and serialization of the documentation so reproduced.

### Run Time

Some type of run time limit should be mentioned in the contract to insure performance of an assigned function such as payroll within a time frame that does not unreasonably usurp machine time.

### Facility Protection Requirements

Simply put, the software package must be compatible with peripheral equipment usage. An example of why this particular provision can be critical would be where the vendor's salesperson recommends a particular package that is discovered to be incompatible with the user's peripheral equipment.

### Error Correction Upgrades

Software contains programming errors which will gradually be discovered at some time beyond the date of contracting for the package. Vendors should provide corrections as well as upgrades improving the quality or efficiency of the package at no cost.

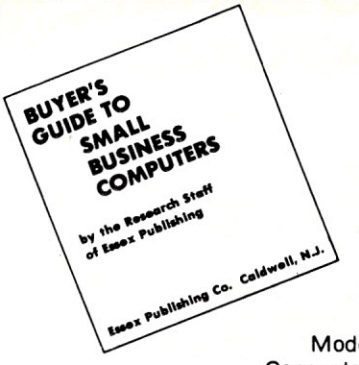
### Compliance with Standards

Such standards provide a benchmark for performance. They may be established by ANSI, Underwriter Laboratories or by custom specifications. The inclusion of such standards provides the user with a standard to measure package noncompliance.

### Miscellaneous Performance Provisions

For the most specialized custom software packages, provisions such as Right to Future Options, Source Availability and Access, Escrow of Source Programs and the Right to Modify might be desirable.□

*The material presented in this column is intended for the reader's general information. The author requests that the reader consult professional advisors prior to applying this material to his or her specific situation. Anyone seeking further information may contact the author directly at One Maritime Plaza, Suite 745, San Francisco, CA 94111.*


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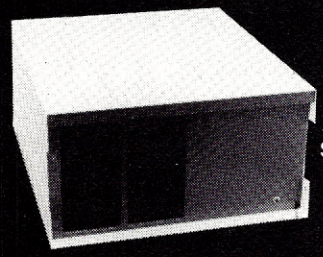
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CIRCLE INQUIRY NO. 24


# MICRO MEDICINE


By Wm. V. Weiss, M.D.
Professional Engineer


## COMPUTERIZED MEDICAL PRACTICE — COSTAR

Outside of some highly sophisticated Hospital Information Systems, no experiment to date so graphically illustrates the potential for comprehensive information processing systems in routine practice as the COSTAR project (Computer Stored Ambulatory Record) in Boston. This project, operational since 1969, was developed in collaboration with the staff of the Harvard Community Health Plan by the Laboratory of Computer Science of the Massachusetts General Hospital.

The Harvard Community Health Plan, a multi-specialty group practice serving a 60,000 patient population, was developed to represent a model of quality prepaid comprehensive family health care. The Laboratory of Computer Science is a research section of the Department of Medicine of the Massachusetts General Hospital and Harvard Medical School.

Some fifteen plus programmer-years were required to bring COSTAR to reliable operational status. Unlike so many false starts in medical "informatics," this system is running well, and is self-sustaining, although the development would not have been possible without HEW support.

The central objectives of the system planners were to:

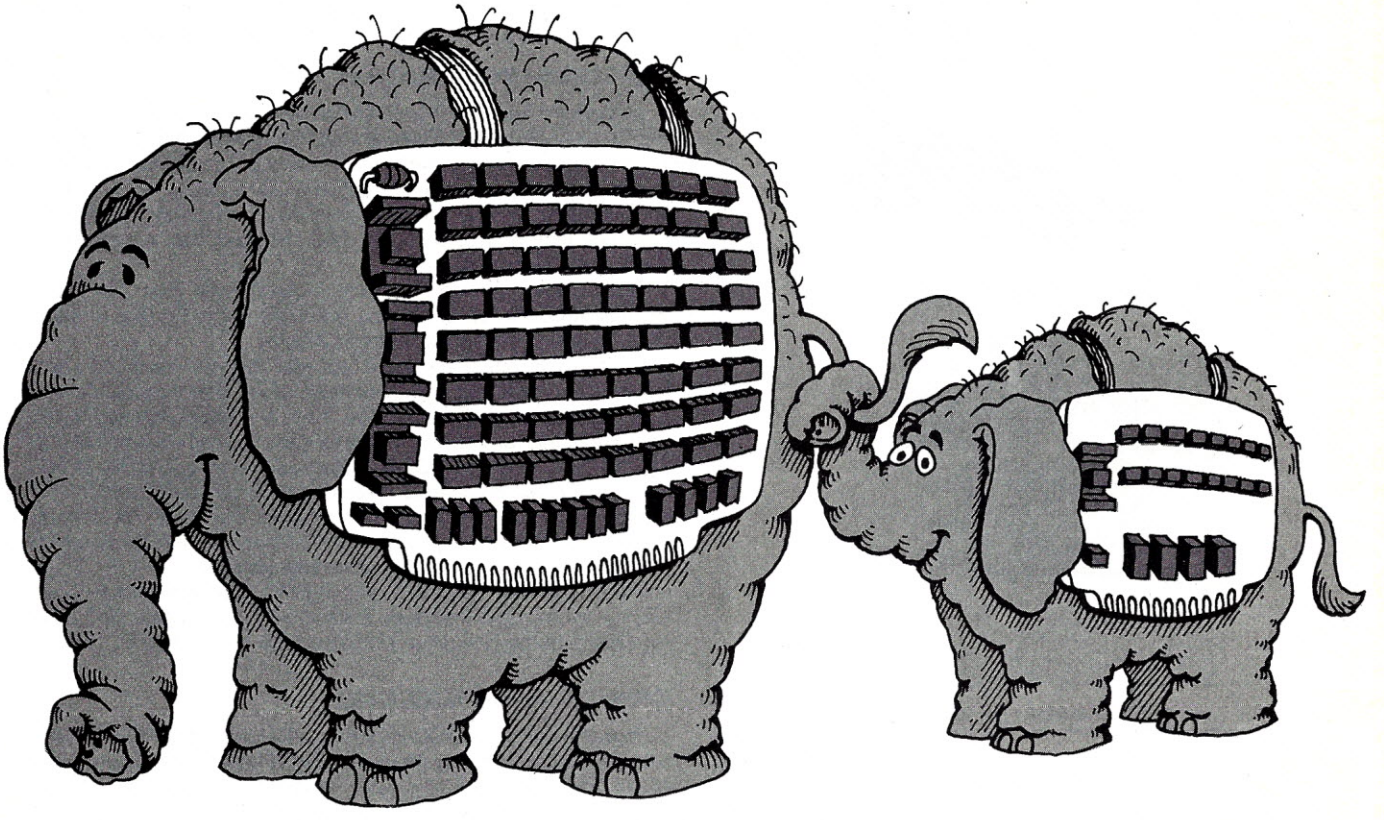
- Provide accurate, timely membership files for a constantly changing patient population.
- Facilitate greater usefulness of medical information by improving availability of information.
- Provide operational support to administrative personnel (scheduling, data base management).
- Provide sound financial data for planning, budgeting, etc.
- Provide database for quality assurance programs, government reports, and other health care research.

The achievement of these objectives required the availability of an information system of significant power and complexity. When the project was undertaken, there were no appropriate database languages. One was developed expressly for a medical data processing environment. Early attempts at data base management systems were written in assembly language, but this had proven to be both expensive and inefficient. Data base management activities are dynamic; it is essential that programs can be easily modified as conditions change.

This can be accomplished only with a high level language. All modules in the COSTAR system were implemented in the high-level, interpretive language "MUMPS" (Massachusetts General Hospital Utility Multi-Programming System). The development system on which COSTAR operated consisted of a Digital Equipment PDP-15 with 48K of 18-bit word core storage, a 3-megabyte fixed-head disk, and seven 24-megabyte movable-head disks. The system can support 30 simultaneous users and a variety of peripherals.

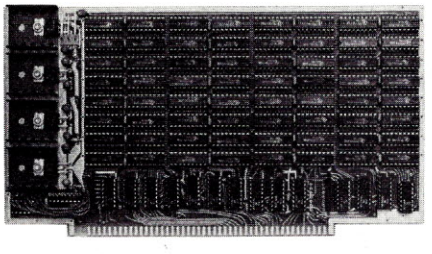
Systems such as COSTAR are still very uncommon and essentially evolutionary in nature. From a functional (administrative) perspective, this project has been a great success. In a large health maintenance organization, membership registration and enrollment is an essential activity as are billing, claims verification, and other accounting functions. The system supports third party billing, fee-for-service, and various other mechanisms of payment. Appointment scheduling is substantially improved with automated methods and communications and follow up with patients is much more flexible and rapid.

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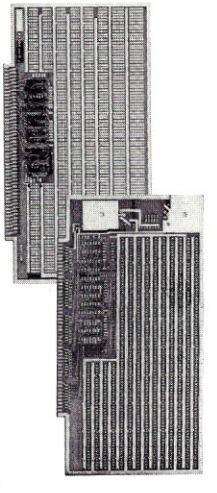
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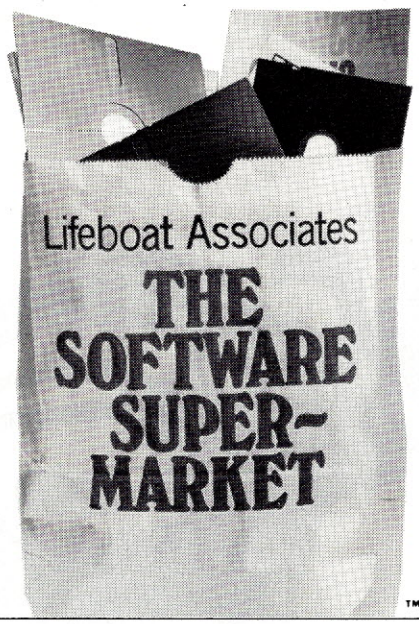
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CIRCLE INQUIRY NO. 6


The most attractive aspect of the system from a physician-user perspective was the elimination of the traditional bulky paper file. This was not accomplished without pain. A highly structured record presents a problem for most physicians who are trained to value their freedom of expression, and the old manual system provided unlimited opportunity for such activities. In fact, most doctors and their assistants to date are not comfortable with the standardized formats and constraints of computer systems. It requires collective effort, desire, and strong central leadership (often seen in group practice settings). However, it is precisely because of such restrictions that a computer provides the user with better information.

## SUPPLYING INFORMATION

To date the principle instrument of medical information capture is the "encounter form." There are several different types. A general form is used for every patient-clinic interaction, and comprises a fairly detailed multiple choice tick-off form which also allows for "free-text" modifier or adjective statements that can be added beside the particular item or separately in a 180-character, free text section at the bottom of the page.

Traditionally, providers (doctors, nurses) write their notes in a manual system in chronological order. As a chart grows in thickness, review becomes increasingly difficult.

In COSTAR, one of the significant advantages to health care providers is the rapid and legible retrieval of medical information in a well organized way. Providers can have a summary printed out in advance of the current visit, or call up greater detail via terminal during the visit if necessary. Of particular value is the availability of flow charts which can graphically present data which would be difficult to visualize with the manual file. Trend plots can point out discrepancies in lab results or physical examination measurements which might be missed in traditional recording systems.

The evaluation of any innovation in health care delivery is a necessary but extremely difficult task. It is important to examine the following factors in the evaluation of the success of this project.

## IMPACT ON PATIENT CARE

Probably the single most important advantage of COSTAR over a manual system is the greater availability of information. In any large group practice, especially with multiple providers in different physical locations, the traditional medical record may not be available in 10-20% of patient visits. In circumstances of telephone inquiry or unscheduled emergency visits the file is rarely available. With a computer-based system, remote terminal access to the record in seconds is the standard.

Legibility and data organization have proved to be a significant advance over old written records. COSTAR data is also considerably more complete than previous records. Programming ensures that requested tests or procedures are actually carried out and the results brought to the provider's attention.

Continuity of care is a growing problem in highly mobile urban medical practices. The COSTAR system gives the provider the option of automatic monitoring of continuity of care and particularly allows the ability to follow special patient populations which require closer monitoring (i.e., those on certain drugs, those with pacemakers, etc.).

## ACCEPTABILITY TO PROVIDERS

The majority of physicians and nurses endorse the COSTAR system. Most felt it takes less time to enter information than with previous methods and prefer the accessibility of COSTAR stored data. These sentiments could not be possible without an intensive and continuing commitment to provider education. The transition from manual to electronic requires a parallel maintenance of a manual system for some time and represents a hidden cost in implementing a computer-based system.

## COST

In spite of research funding, and taking into account hardware and personnel costs, most investigators believe the COSTAR system (medical records and administrative costs) is slightly cheaper than the manual system. Taken in terms of cost per member per year (a population of 40,000 patients), a manual system runs about $14 per file versus $12.50 for COSTAR. Recent advances in hardware will definitely improve these statistics.

## POTENTIAL FOR FACILITATING INNOVATION

Proponents of COSTAR believe two major innovations have been made possible with such a system. The use of a "nurse-clinician" as part of a team concept of health care delivery, and the development of quality assessment and assurance programs which would be impossible without a computer system.

## CONFIDENTIALITY AND RELIABILITY

Using various levels of security (location of terminals, type of information access per terminal, and passwords) the confidentiality of COSTAR exceeds that of manual systems. Reliability has been very high and depends to a large degree on system design, hardware redundancy and the commitment of support staff.

## TRANSFERABILITY

This has been the most challenging question posed to COSTAR developers since this was not a design objective. An information system in large group practice has a personality not easily adopted by other organizations with different goals and operational strategies. The most portable elements are the basic structure and file definitions of COSTAR, the data collecting methods of data presentation and the types of provider interaction with the system. Less transferable elements would be those activities which most closely relate to unique institutional characteristics.

There is a "COSTAR 5" which is a very recent development, and in conjunction with the National Center for Health Services Research and Digital Equipment, the Laboratory of Computer Science expects a more general product to emerge. Such a system will not require special on-site staffing or program support. The only problem is that "MUMPS" programmers are in short supply, slowing the spread of "MUMPS" based systems.

It would be most interesting to hear from any readers who have had health care interactions with centers utilizing extensive data processing systems. I would like your reactions to such facilities. Did you feel more or less humanized by your experience?□

*Dr. Weiss can be contacted at Biolithics, 600 Sherbourne St., Suite 803, Toronto, Ontario, Canada M4X 1W4.*

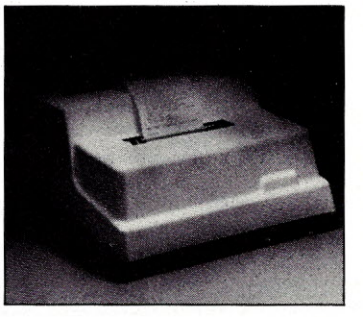

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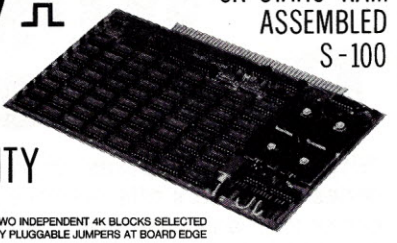
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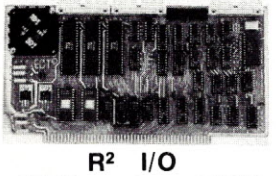
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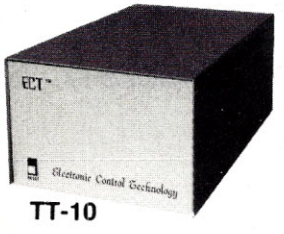
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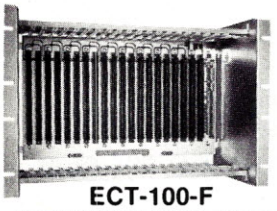
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# THE MICRO-MATHEMATICIAN

By Dr. Alfred Adler

## FACTORIALS AND HYPERBOLIC FUNCTIONS

### Factorials

A factorial, for the sake of those of you who have not yet met this useful creature, is an integer number multiplied by all positive integer numbers less than itself. For example, 5 factorial is $5 \times 4 \times 3 \times 2 \times 1$, which equals 120. It is written as the number followed by an exclamation mark. Thus $5! = 120$.

Factorials are used in probability calculations, permutations and combinations, and in evaluating many infinite series. As an example of a permutation problem, consider the number of 6 digit numbers that can be formed from the digits 1 through 9, if no digit may be repeated. The first digit may be chosen in 9 different ways (the numbers 1 through 9). The second digit, however, since no digit may be repeated, can only be chosen in 8 different ways (1 through 9, not including the first chosen digit). Similarly, the third digit can only be chosen in 7 different ways; the fourth digit in 6 different ways; the fifth in 5 ways; and the sixth digit in only 4 different ways. Thus the answer to the problem is $9^1 8^1 7^1 6^1 5^1 4$, which is the same as

$$\frac{9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1}$$

which can more conveniently be written as

$$\frac{9!}{3!} \text{ or } \frac{9!}{(9\text{-}6)!} = 60480.$$

As an example of a series representation of a function, the series for $e^x$, written as EXP(X) in BASIC, looks as follows:

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots\ldots$$

For values of x greater than 1, the successive terms may increase in value at first, leading one to the conclusion that the series will "diverge," that is, that the sum of the terms will continually increase as more terms are added and the sum will finally become infinite.

This can never happen, however, due to the nature of the factorial. Consider, for example, the (n + 1)th term,

$$\frac{x^n}{n!}$$

Suppose x=5 and n=5. The numerator equals $5 \times 5 \times 5 \times 5 \times 5$, and the denominator equals $5 \times 4 \times 3 \times 2 \times 1$. Clearly the numerator is greater than the denominator. In the next term n=6, the numerator equals $5 \times 5 \times 5 \times 5 \times 5 \times 5$, but now the denominator equals $6 \times 5 \times 4 \times 3 \times 2 \times 1$. The numerator has been multiplied by an additional 5, but the denominator has been multiplied by a 6. In the next term the numerator will be multiplied by another 5, but now the denominator will be multiplied by 7. Clearly the values of the successive terms are already decreasing. Going out to the thirteenth term, where n=12, we have

$$\frac{5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5}{12 \times 11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1} = \frac{5^{12}}{12!}$$

Now the numerator is clearly less than the denominator. This type of series will "converge," that is, after enough terms have been added (and the higher the value of x, the more terms this will require), each succeeding term will be less than the one before in such a way that the sum of an infinite number of terms will be finite, and exactly equal to $e^x$.

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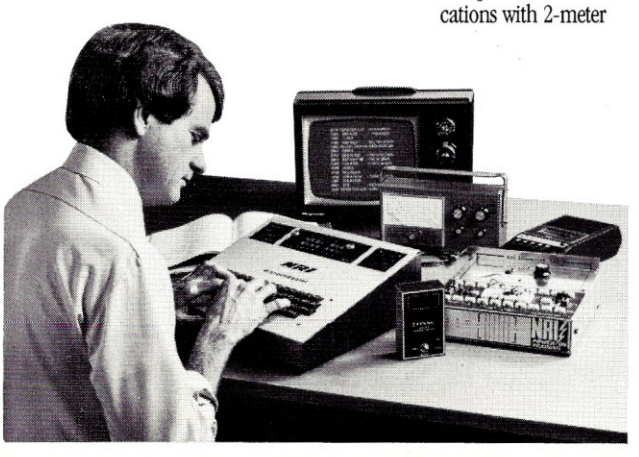
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### Hyperbolic Functions

If we consider a problem involving the interaction of two charges, we find that if the charges are unlike we get attractive forces, but if the charges are alike we get repulsive forces. In the former case, the solution of the equations describing the motion of the charges involves circular trigonometric functions, that is sines and cosines, which are available in most BASICs. In the case of repulsive forces, however, the solution involves hyperbolic trigonometric functions, specifically hyperbolic sine, written sinh, and hyperbolic cosine, written cosh. These same functions constantly reappear in structural problems, heat transfer problems, fluid flow problems; in fact, in every facet of the physical sciences.

It is not accidental that the hyperbolic functions are named similarly to the circular functions. They are geometrically analogous to each other, one being based on the circle, the other being based on the equilateral hyperbola. The details of the geometry are not particularly instructive, and will therefore not be discussed except to state that the permissible ranges of the three most important of the functions.

Comparing the ranges of the circular functions to those of the hyperbolic functions, we find that although the sine and cosine are restricted to the range between minus 1 and plus 1, the hyperbolic sine can vary from minus infinity to plus infinity and the hyperbolic cosine can range between zero and plus infinity. Whereas the tangent varies from minus infinity to plus infinity, the hyperbolic tangent is restricted to the range between minus 1 and plus 1.

Generally, the hyperbolic functions are not available in BASIC. However, they may be derived from the exponential function as follows:

$$\sinh x = \frac{e^x - e^{-x}}{2};\ \cosh x = \frac{e^x + e^{-x}}{2};\ \tanh x = \frac{\sinh x}{\cosh x}$$

The inverse hyperbolic functions are similarly not available in BASIC. They may be derived from the logarithmic function (the inverse of the exponential function) as follows:

$$\text{arcsinh } x = \log_e \left( x + \sqrt{x^2 + 1} \right)$$

$$\text{arccosh } x = \log_e \left( x + \sqrt{x^2 - 1} \right)$$

$$\text{arctanh } x = \log_e \sqrt{\frac{1 + x}{1 - x}}$$

Since the exponential function the the logarithmic function are both available in most versions of BASIC (EXP(X) and LOG(X)), we can take advantage of this fact to write a short program that will generate factorials, hyperbolic functions, and inverse hyperbolic functions.

A listing of such a program, written in PolyMorphc BASIC Version A00 is presented below along with several sample outputs. Factorials for numbers less than 50 (due to limitations of BASIC) may be generated by the command "RUN 60". Sinh, cosh, tanh, arcsinh, arccosh, and arctanh may be generated by the command "RUN 95". Following these commands, the user need only respond to the prompts generated by the program.□

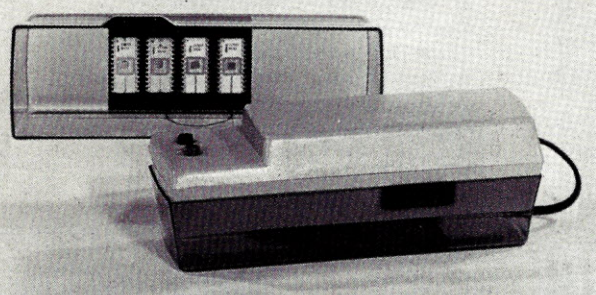
*The author can be contacted at 10360 Flintlock Trail, Tucson, AZ 85715.*

## PROGRAM LISTING

```
L5EC300SJ5EC30
>
Poly 80 BASIC version A00. 4334 bytes free.
>LIST
5  REM*******************************************************
6  REM
10 REM********  P R O G R A M     F A C T H Y P
15 REM
20 REM**************  VERSION  1.0  ****  APRIL  1978  *****
22 REM
25 REM**********  WRITTEN  BY  -  ALFRED  A.  ADLER  PHD  **
27 REM
30 !"THIS PROGRAM GIVES FACTORIALS FOR N<50 AT LOCATION 60."
35 !"IT ALSO GIVES HYPERBOLIC AND INVERSE HYPERBOLIC"
40 !"SINE, COSINE, AND TANGENT AT LOCATION 95."
45 !"STATE EITHER : 'RUN 60' OR 'RUN 95'"
50 STOP
55 REM FACTORIALS OF N<50
60 INPUT "N! = N FACTORIAL, WHERE N = ",N
65 Y=2\IF N=2 THEN GOTO 80
70 FOR X=2 TO N-1
75 Y=Y*(X+1)\NEXT
80 !N,"! = ",Y\!
85 GOTO 60
90 REM HYPERBOLIC FUNCTIONS
93 !"STATE FUNCTION OR 'ARC'FUNCTION; AND ARGUMENT."
95 !"STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT."
97 INPUT1"FUNCTION : ",F$\INPUT"; ARGUMENT : ",X
100 IF F$(1,3)="ARC" THEN GOTO 150
105 E=EXP(X)\E1=EXP(-X)
110 IF F$="TANH" THEN GOTO 140
115 IF F$="COSH" THEN GOTO 130
120 S=(E-E1)/2
122 !"SINH ",X," = ",S
125 GOTO 185
130 C=(E+E1)/2
132 !"COSH ",X," = ",C
135 GOTO 185
140 T=(E-E1)/(E+E1)
142 !"TANH ",X," = ",T
145 GOTO 185
150 IF F$="ARCTANH" THEN GOTO 180
155 IF F$="ARCCOSH" THEN GOTO 170
160 S1=LOG(X+SQRT(X^2+1))
162 !"ARCSINH ",X," = ",S1
165 GOTO 185
170 C1=LOG(X+SQRT(X^2-1))
172 !"ARCCOSH ",X," = +/- ",C1
175 GOTO 185
180 T1=.5*LOG((1+X)/(1-X))
182 !"ARCTANH ",X," = ",T1
185 !\GOTO 95
>
>
>RUN60
N! = N FACTORIAL, WHERE N = 10
 10! =  3628800
N! = N FACTORIAL, WHERE N = 35
 35! =  1.0333148E+40
N! = N FACTORIAL, WHERE N =
Interrupted in line 60
>>
>>
>>
>>RUN95
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : SINH; ARGUMENT : 10
SINH  10 =  11013.233
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : ARCSINH; ARGUMENT : 11013.233
ARCSINH  11013.233 =  10
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : COSH; ARGUMENT : 3
COSH  3 =  10.067661
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : ARCCOSH; ARGUMENT : 10.067661
ARCCOSH  10.067661 = +/-  2.9999999
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : TANH; ARGUMENT : .75
TANH  .75 =  .63514892
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION : ARCTANH; ARGUMENT : .63514892
ARCTANH  .63514892 =  .75
STATE FUNCTION (OR 'ARC'FUNCTION) AND ARGUMENT.
FUNCTION :
Interrupted in line 97
>>
```


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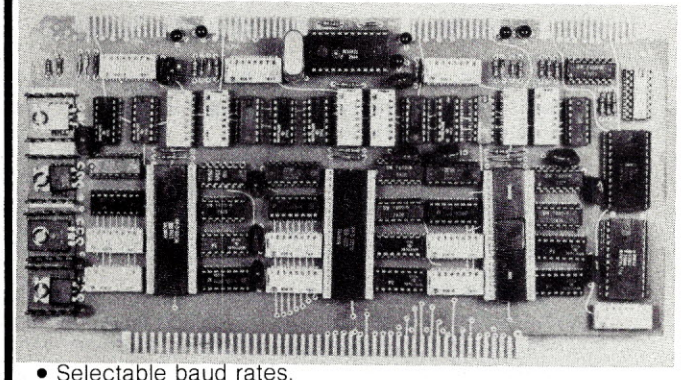
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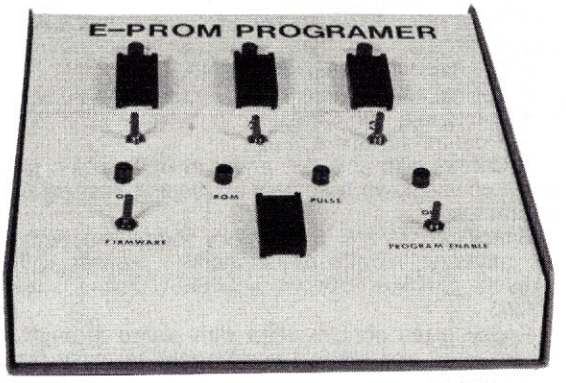
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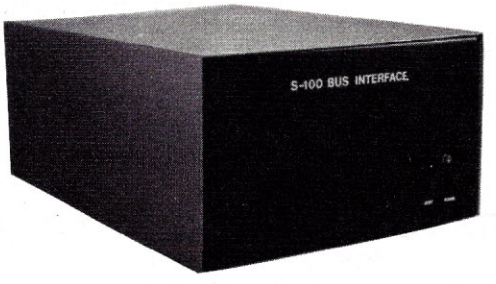
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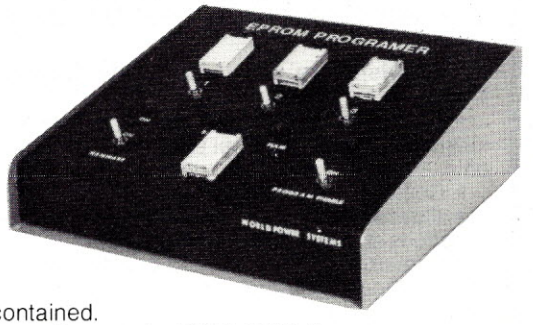
KIT - $129.95 ASSEMBLED $159.95

Option available: 1) 16K RAM Kit high speed 250NS with purchase of board - Special $85.00.

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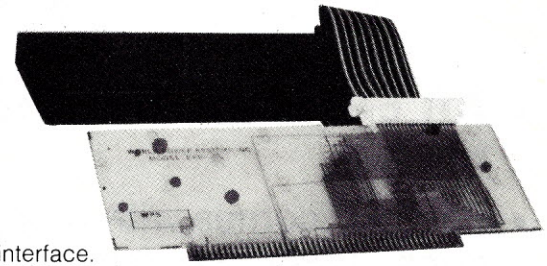

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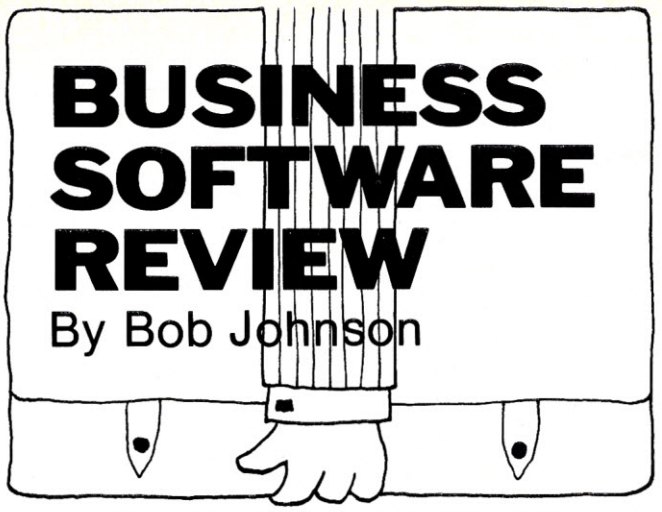
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**WATCH FOR MODULE 50**

# BUSINESS SOFTWARE REVIEW

By Bob Johnson



## THE CONCEPT OF "PACKAGED" SOFTWARE

For businessmen looking for software, there are three alternatives. First, you can write your own. This may be a good choice for someone needing highly specialized software or for a person with a strong background in data processing. Remember, though, that you will be faced with learning the details of the machine's operation, learning a programming language, writing the programs, and then debugging them.

The second alternative is to hire a software house to design custom software. For specialized applications, this is probably the best bet. If you choose this route, you will be paying a reputable company from $10 to $25 an hour until the software is completed. A complete custom software system, consisting of General Ledger, Accounts Receivable and Payable, Payroll and Inventory Control can very easily cost $8,000.

Third, you might opt for *canned* or *packaged* software. These products run much less, because the vendor can sell to a greater market. Most of the packaged software products are billed as "plug in and run" type programs. This may or may not be true, and depends a great deal on your business requirements.

## EVALUATING A "PACKAGED" PROGRAM

Most small and medium sized businesses have similar requirements. All companies need accounting programs such as General Ledger, Accounts Receivable and Payable. There are packages to do these tasks for most businesses. An important fact to remember is that any system will have its limitations, whether it is a manual posting system or an interactive computerized accounting system.

Before going software shopping, you will need to determine the requirements of your business. Arm yourself with figures such as how many accounts are in your G/L chart of accounts, how many customers will be kept on the A/R system, how many employees will be kept on the Payroll system, etc. Until you know these figures, you have nothing by which to evaluate the possibility of using a certain software package. If, through your lack of preparation, you choose a package that simply can't handle your business' informational requirements, you have no one to blame but yourself.

Now that you know what the software should be able to do, your problem is to eliminate those packages which don't fit the bill. Hopefully this can be done by visiting your local dealer. He should be able to demonstrate the software he has available and answer your questions.

Before you actually buy, it is a good idea to get your dealer to guarantee that the software will perform as he claims. If any changes will be required, make sure that he is able to make those changes. Also check to see if he provides installation and training.

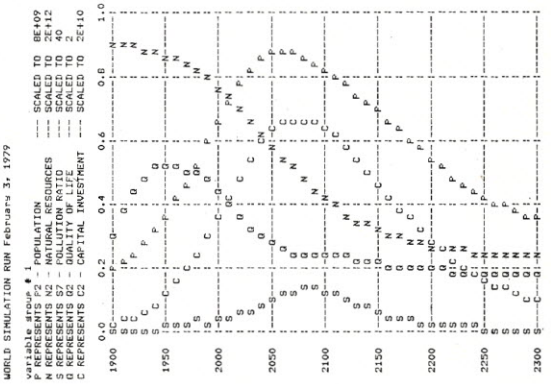
Although most packages are designed so that the end user can set up the package himself, we would recommend that someone familiar with the package help in the set-up and training. The use of someone familiar with the system will save much time and effort in installation.

Another note — when setting up any package, you should first set up some "dummy files" to work with. Use the system on the dummy files until you understand it. Then, to be safe, parallel your current accounting with the system for a couple of months to be sure of it, before you completely convert your accounting.

There are good software packages available. If you take the time to evaluate those packages, you will be able to save yourself a great deal of time and money in the installation of your business system.


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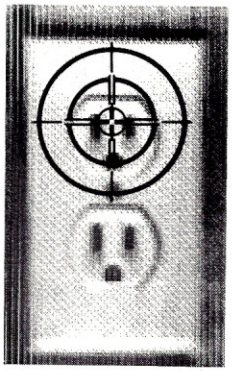


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## THIS MONTH'S SOFTWARE — STRUCTURED SYSTEMS GROUP

Structured Systems Group currently offers four packages. These are NAD™, QSORT™, General Ledger and Accounts Receivable. At the time of writing, they had not yet released their Accounts Payable package. All of the SSG packages are designed to run under the Digital Research CP/M operating system and its offshoots (CDOS and IMDOS come to mind). The NAD, G/L and A/R packages also require Software Systems' CBASIC-2, available separately.

### NAD — Name and Address Record Selection System

NAD is a general purpose name and address file maintenance system designed for use by small businesses in keeping lists of suppliers, customers, vendors, etc. It will require that you have an 8080 or Z-80 CPU, 48K of continuous RAM memory, a 132-column printer, a video terminal, at least one disk drive, CP/M, and CBASIC-2.

The format used by NAD has 8 fields:

- Name — 25 characters
- First line of address — 25 characters
- Second line of address — 18 characters
- City — 15 characters
- State — standard two-letter abbreviation
- Zip — seven numbers or 9-character international postal code
- Phone — up to 13 characters
- Reference Field — user definable length

The lengths stated are for the fixed-field structure. Optionally, you may choose a variable-field structure which allows a total of 83 characters in the first four fields with maximum lengths of 30, 30, 30, and 24 respectively.

One of the nice features of NAD is the ability to "flip" names to allow for alphabetical sorting. For instance, 'The Computer Store' can be entered as "Computer Store*The". In all printouts it will appear as "The Computer Store", but will be sorted by "C" in 'Computer' rather than "T" in 'The'.

The reference field can contain any information the user wishes, and the legnth is user defined when the file is created. A typical use would be to specify a geographical zone, discount schedule, and credit arrangements in a list of dealerships. All names in a file may be sorted or "extracted" by use of the reference field. You could, for instance, extract a list of all dealerships who are on 30-day open accounts and buy at a 20% discount by using the information in the reference field.

When the NAD files are sorted into any particular order with the SSG QSORT package, the user can extract names within a given range of information. For example, you could extract a list of all customers with zip codes between 45000 and 61287. (The full use of this "ranging" capability does require QSORT.)

Four programs are supplied as a part of the NAD package. The first is NADENTRY, used to build and edit the name files. The user specifies which file is to be worked on by name, and the system will find the file, if it exists. If not, it will ask if the user wishes to create the file. The functions involved in editing a file are add, change, delete, examine, save, and stop (exit the program).

The second program, NADPRINT, is used to print master listings of any name and address file. The user has the ability to "range" or "match" during printing. Matching is the ability to specify a certain pattern within any field and receive a printout of all records which match that pattern. Example - the user wishes to develop a list of all the "Smith's" in a certain file. He would use NADPRINT with the match option and specify that the system match "Smith" in the name field. The list would then be composed only of the records with the name "Smith".

The third program, NADLABEL, is used to print mailing labels and envelopes. The user has the option to print the entire file, range, or match. The user can print on envelopes, single labels, multiple label sheets, or non-standard label sheets.

The fourth program, NADXTRAK, will create a new disk file in which the records have been extracted from an existing file. The user may have the program extract by ranging or matching.

### QSORT — Full Disk Sort/Merge for CP/M

QSORT is a high-speed sorting utility for the CP/M operating system. It will sort any CP/M disk files, up to a full diskette, on up to five keys. The user can choose either numeric or alphanumeric, ascending or descending order.




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One note, sort/merge refers to the actual technique used for sorting. QSORT will not merge two disk files together in sorted order. You can use the CP/M PIP program to append the two files together and then use QSORT to obtain the same result, though.

QSORT is controlled by a parameter file stored on the diskette. This parameter file may be created by using the DDT or ED CP/M utilities, or by use of the QPARM program supplied with the diskette.

QSORT will work with any CP/M files, and I have used it with files created by Cromemco 16K BASIC, Microsoft BASIC, and CBASIC-2, all with great success. I feel that QSORT is a valuable CP/M utility, and QSORT is used by the SSG G/L and A/R packages (a modified version which cannot be used as a separate utility is supplied with the G/L and A/R packages.)

### General Ledger

The G/L package is a general-purpose general ledger package for small and medium sized businesses. It includes the general ledger, the general journal, and the cash disbursements journal. The G/L package can optionally be used for multiple profit center accounting or branch office accounting. All posting is done by the double-posting method and transactions are handled in *batches*.

SSG has designed the package to do extensive input error checking, including assurance that all entries balance. Also, the G/L system keeps backup files (father and grandfather files) of all previous transactions. These can be used for auditing purposes, or to recover from major errors and system crashes (a crash is a failure which causes loss of data, such as a lightning strike or power failure). Audit trailing is provided by printouts (hardcopy) of all transactions, and by running a trial balance before closing the books each fiscal period.

The G/L system will require that you have an 8080 or Z-80 CPU, a 132-column printer, 48K or more continuous RAM memory, an 80 character wide video terminal, two disk drives, CP/M and CBASIC-2.

### Setting Up the G/L

The first step in setting up the SSG G/L consists of running the Parameter Entry program. This program will ask the user certain questions about the intended use of the package, such as the company name, size of paper used in printing balance sheet and income statement, names of various reports, whether the user wants dollar signs, cents, and percentages printed, when the closing period is, and if the user wants to use multiple profit centers or branch office accounting. (Neither profit centers or branch accounting are required, they are options.)

These answers are put into a "parameter file" on the diskette. From that point, the system will refer to the parameter file any time it requires any of this information. The contents of the parameter file may be changed at any time by re-running the Parameter Entry program.

Next, the user will set up a chart of accounts using the Chart of Accounts Entry program. The G/L package assumes six categories of accounts as follows:

0000 — ASSETS
1000 — LIABILITIES
2000 — CAPITAL
3000 — REVENUE
4000 — EXPENSES
5000 — TAX

Numbers should be assigned each account so that the account will fall within the proper category. The system also allows all numbers between 3600 and 3999 to be used for cost of sales, if desired, and those accounts are treated as expense accounts.

The G/L automatically assigns the title accounts above. The balance sheet and income statement can be formatted by use of "balance" accounts. The balance accounts are any account numbers which end in zero.

These balance accounts will cause the accounts which come after it to be suppressed on the balance sheet, and those accounts which are suppressed will be totaled and shown beside the proper balance accounts.

A "supporting schedule" may also be printed, along with the balance sheet or income statement. (The supporting schedule does not suppress non-balance type accounts and is used to analyze details not shown on the normal balance sheet.)

Up to 300 accounts may be entered into the G/L system, including balance and title accounts. After entering the chart of ac-

counts, the user will sort the accounts and print a chart of accounts listing, proforma balance sheet, and proforma income statement. If any changes are needed, the user may re-run the Chart of Accounts Entry program to edit the chart of accounts.

### Using the General Ledger

There are four steps in using the G/L. They consist of entering transactions, posting transactions, closing the books, and generating reports. All transactions are entered in a batch mode using the JOURNAL program.

The JOURNAL program will check to see if a current "batch" exists on the disk (a batch is a number of transactions which have not been posted). If a current batch is not found, the system will create one. All transactions are then posted into either the general journal or the cash disbursements journal (check register). The transaction batch may be kept open for the entire month, if so desired. After entering the transactions, the user can make a printout of the transactions using the PROOF program. All transactions can then be checked and any errors corrected using JOURNAL. This process can be repeated until the user posts the transactions.

The printout of the transaction batch serves as the audit trail, and one should be generated each time the batch is posted. Posting the batch consists of the following steps. First, the user sorts the batch using QSORT, then the program POST is run. At this point the user may generate three reports.

The first is the General Ledger Detail, which shows all the G/L accounts, their balance last month, the transactions posted, and the current balances.

The second is the Accounts Distribution Report, which shows a detail of all the transactions posted.

The third is the Trial Balance, used to check the books prior to closing.

Closing the books is as simple as running the CLOSE program. After the books have been closed for that period, the user can generate the balance sheet, the income statement, and their respective supporting schedules.

Yearly closing of the books is accomplished by the program YEAREND, which brings the books to a balance brought forward state, ready for the new year.

The G/L package is very complete, and has very good documentation. Much careful thought was used in the design of this package, and it shows.

### Accounts Receivable

The SSG A/R package is designed to manage the receivables for small to medium sized businesses. Provisions are made to keep track of all receivables, receivables aging, and recurring receivables (leases or rental). The package also interfaces with the SSG G/L package. Although the package will handle up to 26,000 separate customers, a realistic limit would be three or four thousand.

It will require that you have an 8080 or Z-80 CPU, 48K of continuous RAM memory, a 132-column printer, and 80 character wide video terminal, at least two disk drives, CP/M, and CBASIC-2. Also, you will need a supply of statement forms.

### Setting Up the System

An experienced person will save you much time in installation. The package is not hard to set up, but you may end up *tuning* the system if you do not completely understand it. (*Tuning* refers to the process of slightly changing and re-changing accounts and parameters to optimize the operating efficiency of the system.)

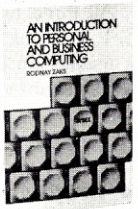
The user will first run the program A/R Parameter Entry program. This program is similar to the parameter entry program for the G/L.

Next, if the G/L interface is to be used, or if you wish to generate sales reports, the Account Entry program is run. This program will create the accounts and account numbers used in the A/R accounting and G/L interfacing.

The final, and largest, step in setting up the package is creating customer files with the Customer Entry program. *A note on customer numbers.* All customer numbers consist of a letter, a three-digit record number, and a check number. This check number is calculated by performing a math operation on the letter and record number, and is used as a check against operator error. It should reduce the possibility of the operator keying in a wrong account number by a factor of ten.


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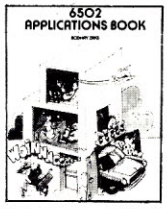
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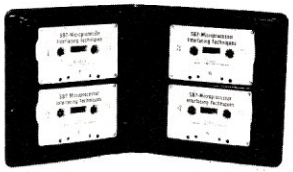
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CIRCLE INQUIRY NO. 53

### Using the A/R Package

Using the A/R package consists of five steps. They are entering transactions, aging the accounts, generating statements on the recurring receivables (Autogen), generating all the current statements, and generating reports.

The three types of transactions entered into the A/R system are Invoices, Payments, an Recurring Receivables. All three types of transactions are posted using batches, as in the G/L. Any batch may be proofed and edited until the batch is posted, usually on a daily basis. The batch proof provides a hardcopy of the daily transactions, and is used as a part of the audit trail.

Aging the accounts consists of running a program called CASHAPP, or Cash Applications, which brings all accounts to current status and ages them by one month. The user may then run the AUTOGEN program, which prints statements for all recurring receivables. This is a valuable feature, as most small businesses have difficulty collecting leases and rentals.

Statements are then generated. If the AUTOGEN program has not yet been run, the statement generation program will remind the user to do so. If the user desires, up to three levels of Dunning Letters may be printed on aging statements.

The A/R system generates several extremely useful reports. One is the sales report, which provides a summary of all transactions period to date, last period, and year to date.

The other reports generated are the Aged Trial Balance Reports, and are the most important reports for the user of the A/R system.

This report is very comprehensive, and will be used as the primary working reference for the Receivables Department throughout the month. The current status of all accounts is shown in detail, and summary statistics are shown for current, total, 30 days, 60 days, and over 90 day old receivables.

The Summary Aged Trial Balance presents a summarized listing of all accounts outstanding. The Exception Trial Balance prints a list of all accounts either late or over their credit limit.

Two other important features of the A/R system are the General Ledger Interface and the Enquiry program. The G/L Interface posts a current A/R transaction batch to the current G/L batch, which is then processed normally by the G/L.


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Each package includes one floppy disk (with source and object code), and a well documented user's manual.

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Pac 1, 3, 4, 5, 7 also available for TRS-80/ CBASIC / MBASIC / APPLE / PET / SORCERER.

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CIRCLE INQUIRY NO. 5


The Enquiry Program allows the user to check the current status and activity of a client at any time. Uses of this program would be to check a questionable credit sale or to answer a customer's inquiry as to his current account balance.

## CONCLUSIONS

The Structured Systems Group software is one of the best that we have seen to date. Much attention was paid to design of the packages. All programs do extensive error checking, provide for audit trailing, and provide full detail backup.

## THE RATING CHART

We have devised a rating chart showing several areas of concern to the potential business user (see Table 1). All software to be reviewed in this column will be rated on this chart, and a cumulative total drawn on each package for comparison.

**Table 1.**

| | NAD | QSORT | G/L | A/R |
|---|---|---|---|---|
| 1. System Interchangeability | 9 | 9 | 9 | 9 |
| 2. Program Interfacing | 7 | 9 | 9 | 9 |
| 3. Maintainability[1] | 0 | 4 | 0 | 0 |
| 4. Documentation | 9 | 9 | 10 | 9 |
| 5. Ease of Installation | 10 | 8 | 9 | 8 |
| 6. User Lock-In | 8 | 10 | 9 | 7[2] |
| 7. User Interaction | 8 | 7 | 9 | 9 |
| 8. Input Error Checking | 9 | 10 | 9 | 9.5 |
| 9. Error Recovery | 8.5 | 9 | 10 | 10 |
| 10. General Design | 8 | 10 | 9.5 | 10 |
| **Cumulative Total** | **76.5** | **85** | **83.5** | **80.5** |

[1]All the SSG software is distributed in compiled form. The end user cannot change the design or function of any of the SSG systems, except within limits allowed by the parameter input programs. If you wish to use the SSG software, make sure that it will do everything needed before you invest.

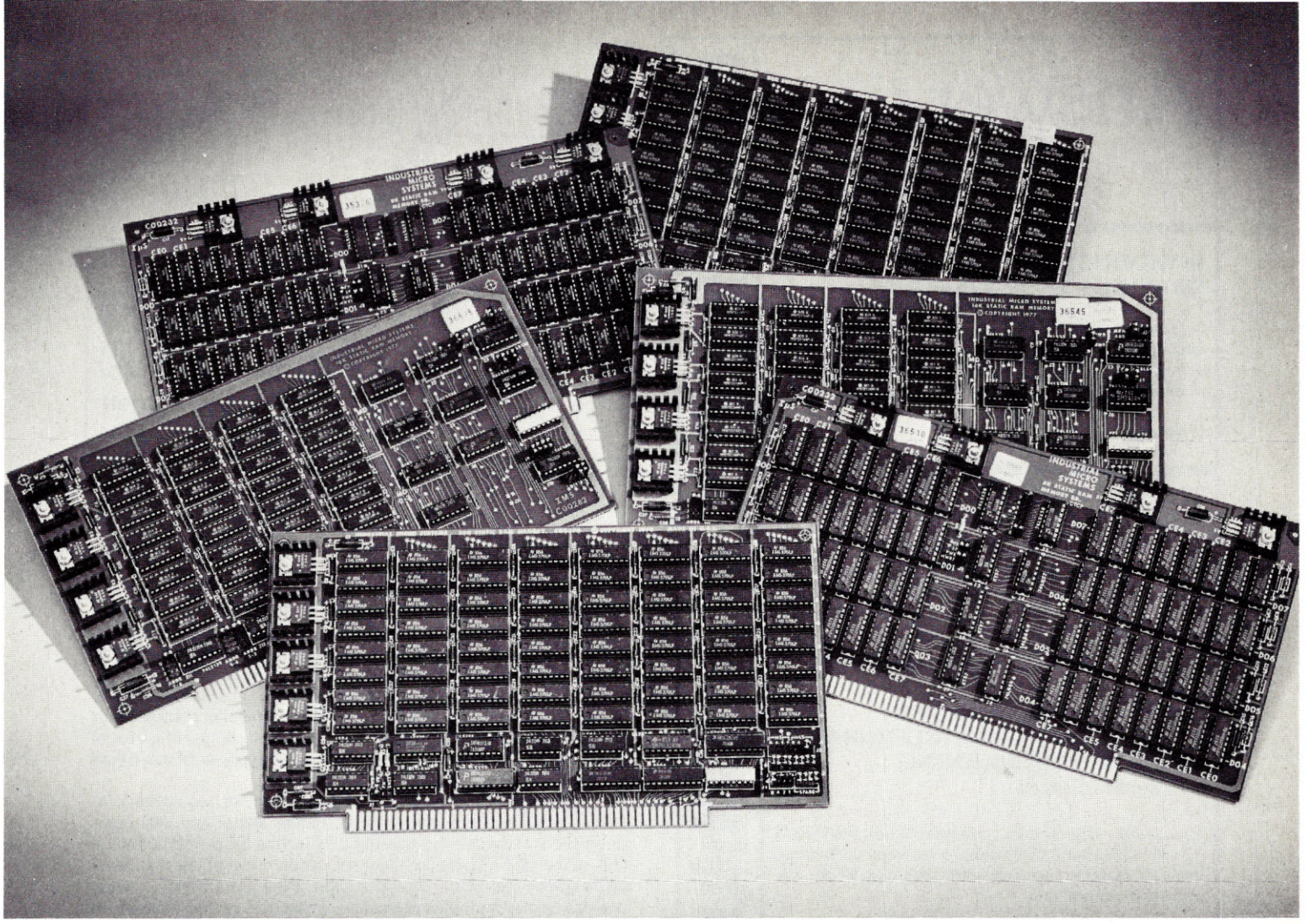
[2]It is probably not fair to rate the lock-in of the A/R package. The A/R system is very well planned, and most companies would have no need for more in a receivables package.

A short explanation of each category follows:

1. Systems Interchangeability — This refers to the ability of the package to run on different systems.
2. Programs Interfacing — This refers to the ability to interface the package to other packages, usually by passing the data through disk files.
3. Maintainability — This refers to the ability of the end user, or a programmer hired by the end user, to make changes to the packages.
4. Documentation — This is an overall evaluation of the quality of operator's guides, user's manuals, and other documentation provided with the system.
5. Ease of Installation.
6. User Lock-In — This category is a measure of the ability of a system to meet the needs of differing companies, and the ability to use the package with other software. A low rating means a high degree of lock-in.
7. User Interaction — Refers to the degree of prompting, self-explanatory messages, and user helps built into the system.
8. Input Error Checking — The ability of the system to check data inputted by the user.
9. Error Recovery — The ability of the end user to recover from catastrophic errors and system crashes.
10. General Design — A subjective judgement on the overall design and operation of the system.

All categories are rated on a scale of 1 to 10, 10 being the best.□


*Carl Heintz and Bob Johnson will be alternating as authors of this column. Software vendors who are interested in having their product reviewed can contact Carl Heintz at 2540 Huntington Dr., San Marino, CA 91108. Bob Johnson can be contacted at 7228 W. Reno St., Rt. 5, Oklahoma City, OK 73108.*



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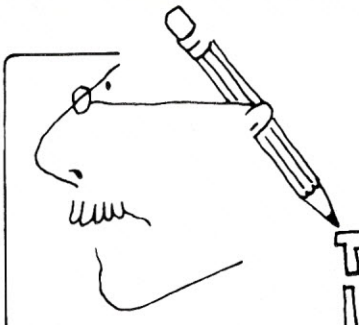
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# THE INVENTOR'S SKETCHPAD

By Roger Garrett
Northeastern Regional Editor

## CASSETTE COMMUNICATOR

I have a PET™ computer at home and a friend of mine has one, too. While discussing the many amazing things we could do with these toys, we happened upon the idea of allowing them to talk to each other. Now, I don't mean natural speech generation and recognition, I mean transferring data from one computer to the other so that, for instance, we could use them to do parallel processing or implement a multi-terminal Star Ship simulation, or any of a host of applications where we could use the processing power of more than one central processor.

I considered using the 8-bit I/O port, but we would have to develop machine language routines, handshaking, and data communications standards. So how about using the IEEE-488 bus at the back of the PET? There are plenty of standards set up for that and it would simply require a connecting cable. Well, Commodore has yet to supply me with usable information on the bus, so that is out of the question for the time being.

So what else is available that already has established communications standards as well as easily usable software? The cassette decks, of course. But how can we get the cassette units on our two PETs to communicate *directly* without dumping data to a tape on one unit, carrying it to the other unit, and reading it in? Well. . .

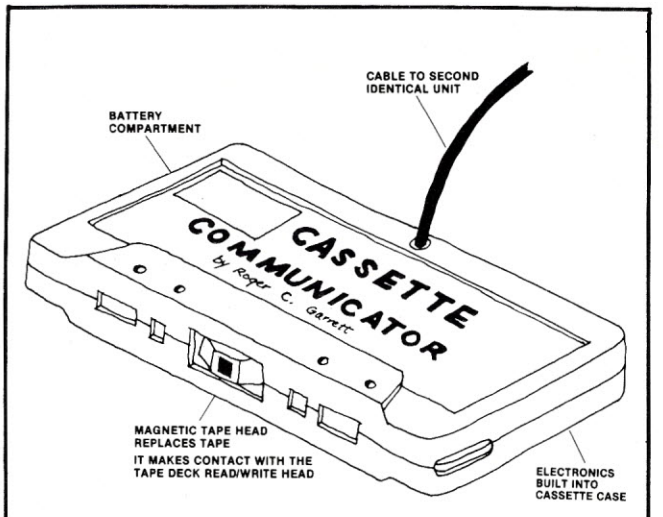



**Figure 1.**



CIRCLE INQUIRY NO. 15

## FIGURE ONE

Suppose we take two cassette tapes and remove the insides, tape and all. At the position where the tape normally makes contact with the tape unit read/write head we mount a tape read/write head. Inside each cassette we put a simple amplifier circuit powered by a battery and we connect these two *Cassette Communicators* with a cable. Assuming we design and connect up the amplifier circuits correctly, then whatever magnetic fluctuations (data) that occur at one magnetic tape head in one cassette are transmitted to the magnetic tape head in the other cassette.

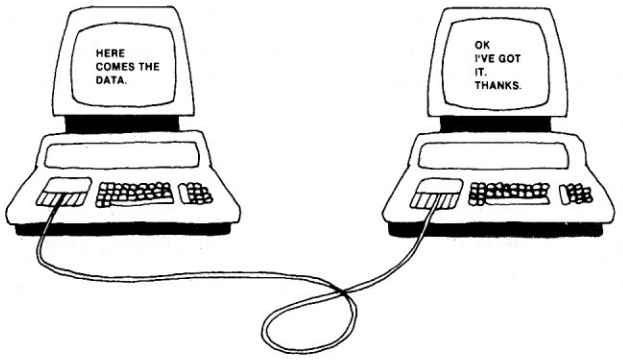



**Figure 2.**

## FIGURE TWO

We turn on our PETs, get the appropriate programs running for whatever our application happens to be and load the cassette communicators into their respective tape units. The PETs can now communicate using high-level BASIC commands like LOAD, SAVE, GET#, and PUT#. The beauty of this form of communication is that it will work for any two computers with identical tape data formats such as between two TRS-80s™ or two APPLEs.

How about a multi-terminal, multi-user Star Trek? □

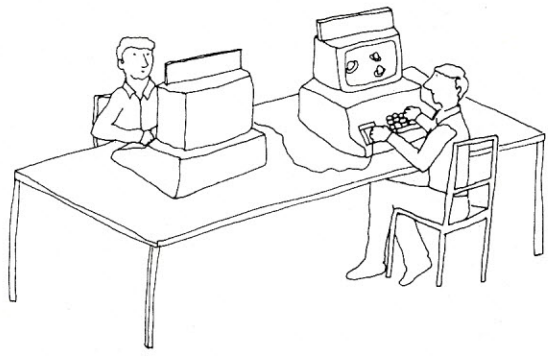


**Figure 3. Possible multi-terminal, multi-user setup.**

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Not only will the series detail some of the finer points of the language and the steps necessary for implementation, but it will also explain the reasoning behind their implementation. By explaining the theory that formed the basis of the language, Davis will give the reader an understanding of all languages. By the end of the tutorial, serious readers will be able to write their own language.

The PASCAL Notebook will be of interest to all those who are interested in language design or who simply want to learn how to use PASCAL.

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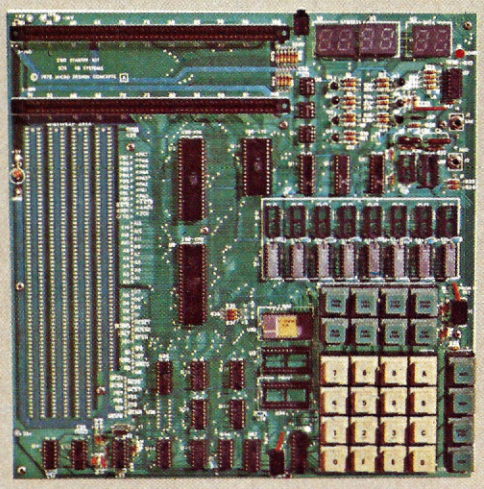
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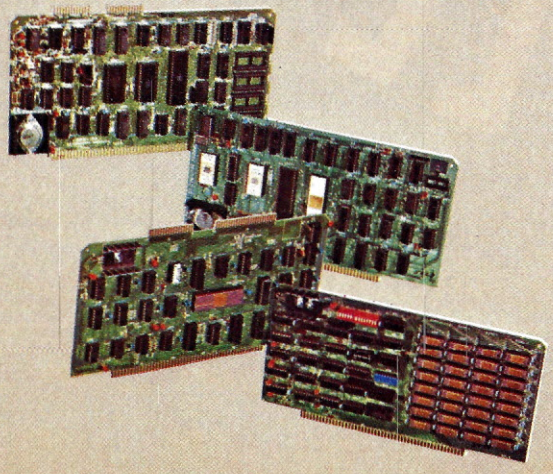
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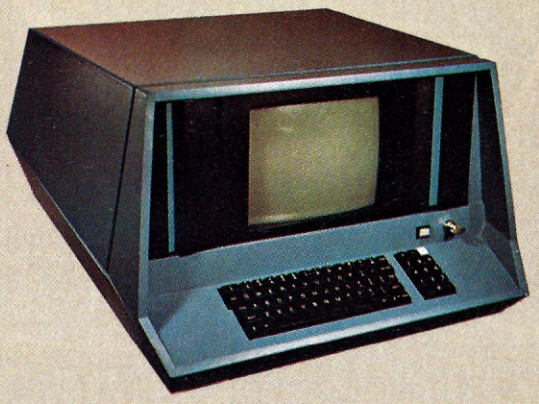
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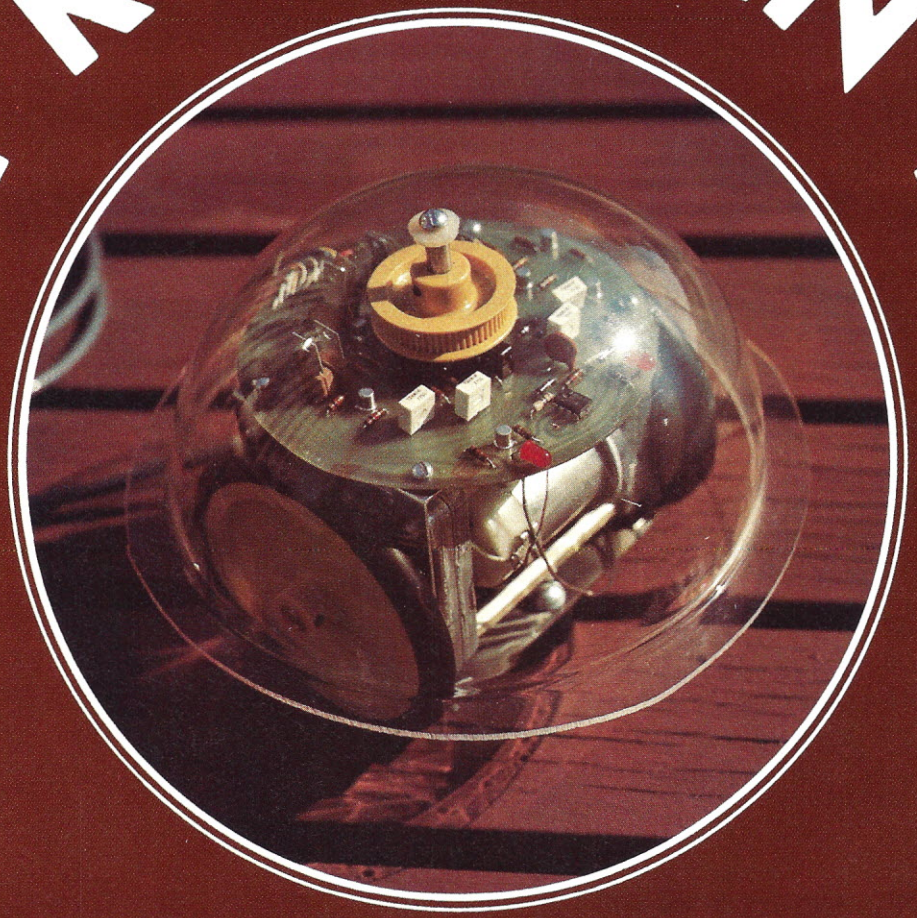
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# A ROBOT IN A SHELL



By Roger C. Garrett, Northeastern Regional Editor

The major obstacle for most robotics enthusiasts is not the lack of intelligence simulation software. They more than make up for that in their own ingenious and inventive ideas and techniques. Nor is it the availability of computers, what with $600 systems so simple that anyone afford them and easily put them to use. What is hampering the field of robotics is the unavailability of simple hardware with which to make the robot itself.

An adventurous company known as Terrapin, Inc. now manufactures a roving robot named the Turtle™. It should just fit the bill for all of those robot tinkerers who have been waiting for just such a device.

At a recent meeting of the Rhode Island Computer Hobbyist Club, David McClees, president of Terrapin, Inc. demonstrated his Turtle. It is not a large robot, but it contains enough controllable hardware to demonstrate the basic, and possibly some quite advanced, techniques in robot control.

## GETTING AROUND

The Turtle has two strong motors which individually drive the two large wheels. There are also two small "toes" at the front and back which provide stability. These toes are merely hard plastic balls which do not rotate but skid on the surface. A roboticist with the tinkerer's touch might substitute casters but the skidding of the toes in no way hampers the mobility of the Turtle.

The wheels are individually controlled, on-off and forward-reverse. There is only one speed for the motors but other speeds can be achieved simply by turning the motors on and off quickly. The inertia of the wheels make it run smoothly at just about any speed, but it can only operate on relatively smooth surfaces. Carpeting is like quicksand to the Turtle. But that should not be a problem for most applications.

## WHERE AM I GOING?

At the top of the clear plastic dome are four normally-open switches. These just barely touch the inside surface of the dome which hangs freely on a ball-and-socket joint. When the robot bumps into something or some other mobile vehicle bumps into it, it deflects the dome and activates one or two of the switches. By reading the status of the switches, the controlling software can know which octant of the dome was touched. This information can be used, for example, to cause the robot to 'track' a wall through a maze or search a room for an object of known shape.

## LISTEN TO ME

The Turtle can announce its presence or appear to be responding to stimuli in three ways. It has a speaker which can produce two distinct tones or simply be silent. The tones are produced by a 555 integrated circuit. This means that the speaker can be turned on to a tone and then continue on to other tasks with the sound continuing without further input.

The limitation to two tones may be a problem for some experimenters. It might be nice, for example, to have the square wave of the tone generated by the computer itself, thereby allowing any audible frequency to be sounded. There is plenty of room for such tinkering within the dome.

The second form of output is a set of two red LEDs at the "front" of the Turtle. (Front, of course, is relative in a device which is basically symmetrical in most other respects.) The lights can be turned on or off, although they are not individually controllable.

Both lights and the speaker, while providing little interaction with its environment, do help to give the appearance of intelligence when under computer control. One demonstration given had the little fellow blinking his lights each time he encountered an object. It was as if he was saying "pardon me for bumping into you."

If the lights and sound are not enough for the robot to let you know what he is thinking, then he can always write it. Mounted on the underside of the robot is a solenoid-activated pen which can be lifted up or placed in the down position so that it writes on whatever surface he is moving over. Couple the pen control with motion control and you have a simple plotting device. While it is not advertised as a highly accurate plotter, the demonstrations given for the club were quite impressive. If the motors are tuned properly and extra care is taken in controlling those motors, taking into account the startup speed and so on, impressive drawings can be made.

## NOT TOO SMART BUT LOTS OF POTENTIAL

The Turtle does not have any "built-in" intelligence. Indeed, it has no CPU or memory at all. It is strictly an Input/Output device. To add intelligence to this robot, he must be connected to a brain, either a human's (via joystick or similar direct control) or a computer's. The connection is provided by a ten-foot, fifteen-connector cable. Additional cable is available so it can roam throughout the house rather than just within the living room. The cable also has the drawback that the Turtle sometimes gets tangled up.

It might be possible to substitute a radio, audio, or light-beam link with the robot, although this would require on-board power supplies and serial-to-parallel conversion circuits. Even if the cable could be made to come out of the top of the Turtle instead of the bottom, it would help. A hole might be cut in the side of the dome with a bracket connected to the base and going out through the hole to the top. The cable could then be taped to the bracket and the free end suspended from above.

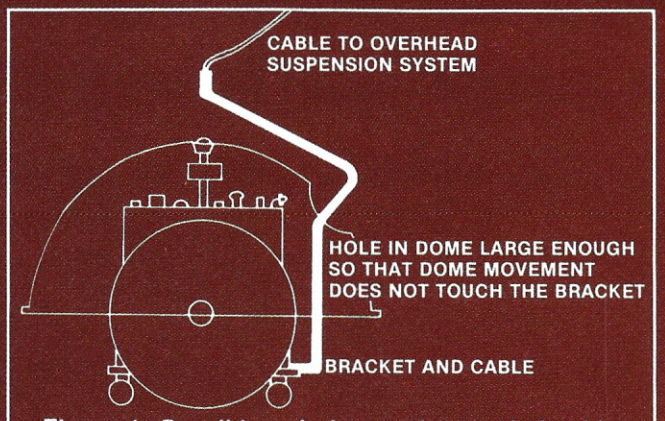



**Figure 1. Possible solution to the tangled cable problem.**

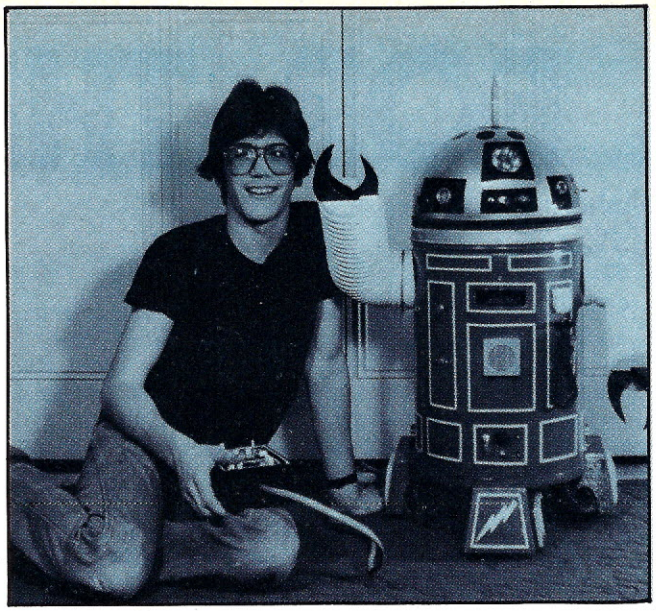
## PUT ME TOGETHER

The Turtle can be bought either in kit form at a cost of $300 or assembled and ready to go at $500. I would suggest going for the kit. The assembly manual that comes with the Turtle is well written and sufficiently illustrated. In guiding you step by step through the assembly, it is comparable to a Heath Kit manual, although it is printed on standard stock paper, not the glossy (and expensive) kind of manual Heath uses. But it is the information content that counts and on that score the Turtle manual gets high marks. Just be sure to follow the instructions. The reason most people have problems with kits is that they don't follow the manual.

## THE POTENTIAL

The Turtle, above all, is a tinkerer's delight; not that it requires a tinkerer to build or use. It is well designed and the robotics experimenter can gain untold experience from running this little guy. But its potential for expansion is infinite. One cable line is left free for user expansion but plenty of room is left inside for those little extras everyone will think of adding. How about some on-board intelligence, a grasper-like hand, sonar location sensors, humidity sensors, heat and light detectors, and on and on? The robotics enthusiast now has available the vehicle with which to apply his ideas and expand our knowledge of mechanical intelligent creatures. □


A
ROVER
ROBOT
Scoops Soil and Tests Water



## By Robert Profeta

*Robert Profeta is a 15-year-old high school student who lives in Vineland, New Jersey. He is currently working on the plans for his fourth robot.*

I've always liked science, chemistry and electrical things. When I was still in elementary school, I started building electric motors and Morse code tappers from tin cans and whatever junk parts I could find. Later, my father bought me electronic kits to assemble and books to read. Eventually, I began to design and build my own circuits.

As a science class project, we were required to build something at home. I chose to build a robot. Both my teacher and classmates were very impressed.

Then I saw *Star Wars* and was inspired to build a radio controlled robot similar to R2-D2. I called it R2-P2. My third robot is of my own design and is named SB-3400.

Before beginning SB-3400, I thought a lot about what I was going to do even before I sat down at my drafting board. After about three weeks of work designing the robot, I was ready to begin construction of my *Mars Lunar Rover Robot SB-3400.*

First, I obtained a large tin can, approximately 12 inches wide and 18 inches high, similar to a lard can. I spray painted it once, sanded it and painted it again for a smooth, professional look. For the dome, I got a clear plastic, rimless dome. I masked off certain areas and painted the inside silver, then removed the masking tape and sprayed the remaining sections black. This formed the black panels and designs. The outside of the dome has a smooth, glossy appearance.

The next step was to construct the boots, which contain the drive motors and a swivel wheel. Using half-inch plywood, I made three boots and bolted them to the bottom of the can. Then reversible, geared-down motors were installed in the rear boots. In the front boot, a swivel wheel was installed. A motor and pulley were attached to the dome so that it could rotate either to the right or to left. SB-3400 is powered by a 12-volt motorcycle battery. I control him by using a control box attached to a long extension cord. The robot is 32 inches tall and weighs 35 pounds.

Electronically, I installed a heat sensor that sets off a buzzer and blinking LEDs when the temperature goes over 135° or below 34° Farenheit. Other electronic devices included a photoelectric burglar system, an infrared emitter and an infrared detector.

The robot also has a magnetic field detector wired to a calculator so that when it passes over a magnetic field, the calculator will count it. By pressing a button, I can have SB-3400 indicate the temperature.

He also has a sample tray that can be filled with water and inserted into a slot in his chest. The purity of the water is then tested. An LED is hooked up to a circuit, so I can see how pure the water is. If distilled water is used, the LED won't light because no current flows through the water. With normal tap water, the LED glows at a medium brightness. When contaminated water is tested, the LED glows brightly because more electricity flows through.

I have also hooked up a lie detector using the same principle. I have someone touch two electrodes, then set the dials on SB-3400 for the person's tolerance. When the person lies, the meter goes up because when he perspires his body conducts more electricity.

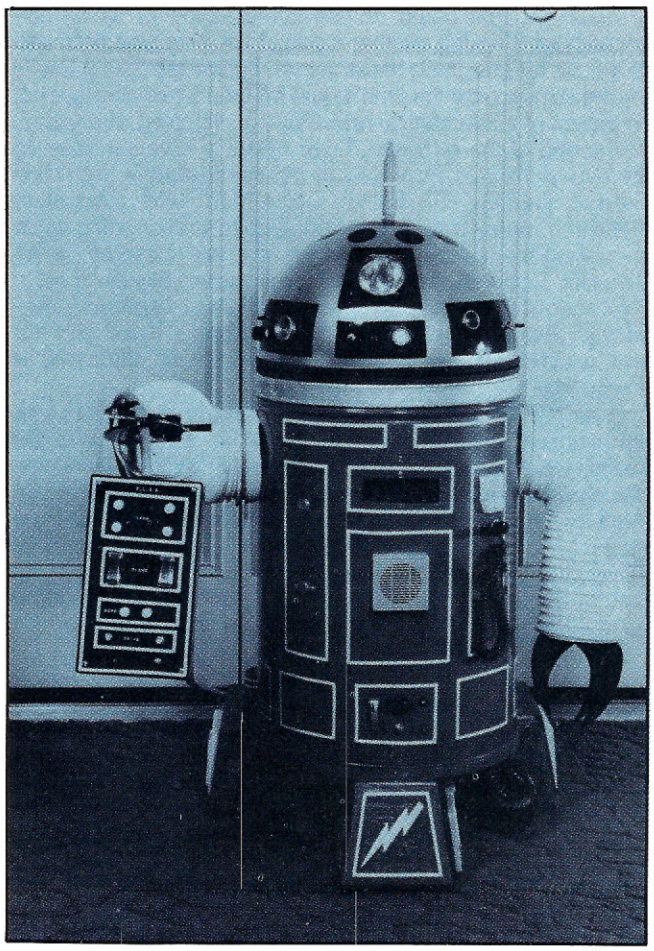
The next problem was to make arms that could move up and down with claws that could pick up or hold objects. The arms and claws were cut from aluminum sheets. Motors were installed inside the can to power the arms and smaller motors were attached to the arms to operate the claws. I used dryer vent hoses to conceal the mechanics and cover the arms.

When I show SB-3400 to people, I have him take a glass of water from them and give them back. And if a small scoop is placed in his hand, he can be made to scoop up earth samples.

After I had nearly completed the robot, I installed a cassette recorder and made a tape so he can talk in beeps and computer sounds. He can roll up to someone, point the light in his dome at them and appear to talk to them. As he goes up to the person, he travels at a normal walking speed.

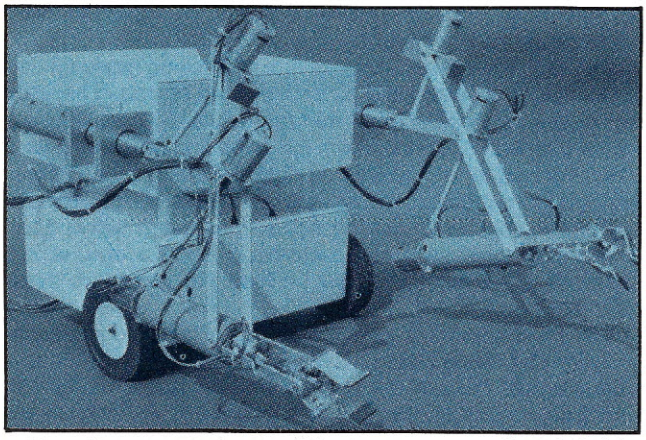
Because I already had the tape recorder and most of the wood used in the base, SB-3400 only cost me about $100. I also saved some money by using parts from some wrecked cars. With all new parts, the robot probably would have cost about $250.

When I was finished with the robot, I said this would be my last one. But I thought of some other things I'd like to try, so I'm now planning a DC-Prober.□



# REACHING FOR THE

By John K. Gallaher, Jr.
Gallaher Research Inc.
P.O. Box 10767, Salem Station
Winston-Salem, NC 27108



The Grivet was the world's first mass-produced hobby robot kit. Whatever else may be said about the product, it was still a bold leap forward into a new market. It was crude, jerky, and clumsy, but it was alone in its class. Looking back, the Grivet made history, but its inventor made a grave mistake, which almost destroyed its future.

I built my first working arm and hand arrangement in 1972, during a winter semester at Wake Forest University. The project involved the construction requirements and operation of a prosthesis that could imitate every action of its human counterpart. Lacking another model, I used my own right arm as a scale for designing the structure. I perfected the hydraulic mechanisms so that the limb would fall limp when de-activated, an aspect of a mechanical arm I have never seen duplicated. At the end of the semester, I was asked to give a lecture on the new principles employed in my configuration. Ironically enough, the new "Six Million Dollar Man" was to premiere that same night. Unfortunately, I slipped on some ice while coming to the lecture hall, and the arm was shattered on the sidewalk. I gave the lecture, but there was no demonstration.

For about five years, the work of starting a business pushed my robotics interest into the background. But I kept the arm, which had been repaired, hanging on my office wall as a reminder.

In January, 1978, I approached my board of directors with the proposal to market a hobby robot kit. The idea was not warmly welcomed. The more conservative members were worried about committing large sums of money toward developing a new market. I was told that before a prototype could be made, I had to offer proof that there were enough people out there who would buy such a product. So I ran an ad saying that "the robots are here," which was only half true. We did have a design, but we did not have any kits built.

The response was unbelievable. Within one month, we received over four thousand cards and letters, not to mention phone calls and personal visits. But that was only the beginning. Soon after the board of directors gave me the green light on building a prototype, a completely separate project was being finished. The new business system we had built was to be announced publicly in a story a local reporter was assigned to cover. We had all of the letters and stacks of reply card labels scattered atop a table next to where she sat to interview us. Halfway through our conversation, she happened to read part of a letter. The room fell silent, as I and my fellow worker turned white. In our excitement over the newspaper coverage, we had forgotten to put away our secret.

She started asking questions about our correspondence. Every letter had at least one reference to the word "robot." We could not very well hide what the replys were about. But to make things worse, she found a drawing of the proposed Grivet arm. The interview followed a different path from that moment on. She must have taken the piece of paper with the drawing, because the next Sunday paper had a rendering very similar to it.

We had made the front page! The next Monday morning all hell broke loose as the phone calls from other papers, television stations, and radio commentators came rushing in.

The first brochure covering the Grivet was sent out before a working prototype was completed. We were being swept up by the winds of fate, as pressure from excited hobbyists demanded a response. We changed the design three times before the famous Grivet prototype was pictured on the cover of our second brochure. Orders began to follow, along with advanced payments. We had to do something soon, or the whole business would go down the tube.

Then the factory told us that our cost would be four times the estimate, so long as we insisted on using the cylinders in the arms. I had to redesign the components used to rotate the wrist and upper arm or call it quits. Within weeks the first re-modeled Grivet arm was delivered. I never liked the spiral approach, but without it, there would never have been an armed-robot kit sold in 1978.

We had our share of complaints and returned kits, but on the whole, most of our customers realized that they were taking part in pioneering a new frontier, so they did not mind the few faults and blemishes the Grivet had. We heard of many modifications and listened to every suggestion. Before long, we had redesigned the Grivet arm actuators, and began work on a new robot parts catalog.

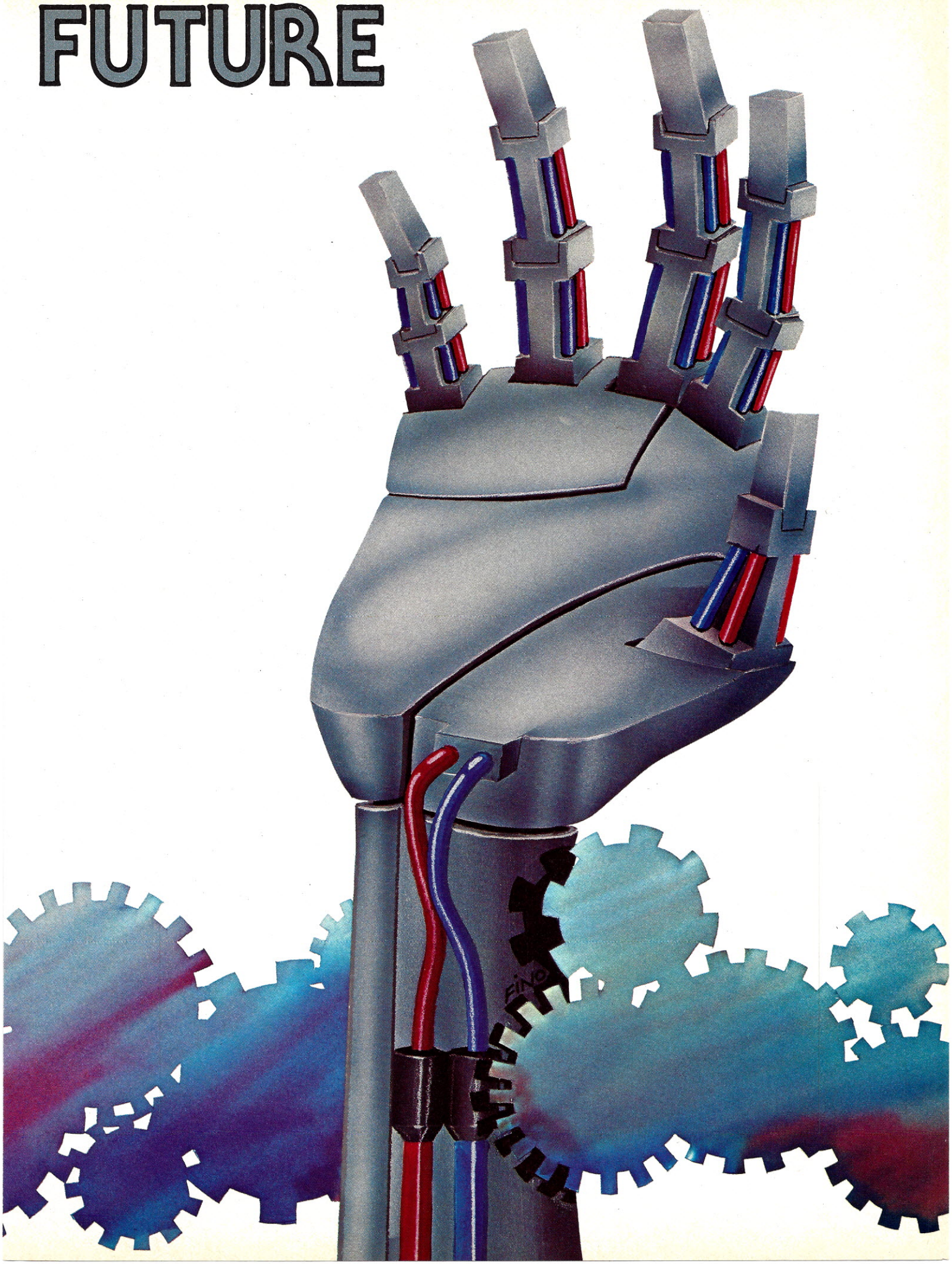
I knew that the majority of the people who did not buy our kit were waiting for a design that they liked better. The only way to please everyone without producing a thousand different models was to produce parts that were interchangeable and could be assembled in a thousand different ways. We wanted to offer a complete system of modules too, including electronic systems for control and feedback. Sensors were designed, interface boards laid out, and experiments begun on aural communication. We did not want to be pushed into another corner, and to make the same mistake twice.

The new catalog was the final solution. It was how we had envisioned doing it in the beginning, but had never had the opportunity to try. We knew that we could sell the catalog as if it were a book, informing people of how simple it really was to design and build a robot, if given the proper tools.

Designed to be self-contained, the Grivet was a true robot. It had arms and hands with which it could manipulate its environment, though not without difficulty. It could host its intelligence and source of power. It set a standard for all future robots to follow.

There will never be another kit like it on the market again. We withdrew it in December of 1978, in preparation for the catalog approach to the market. I took up the last Grivet arm we ever made and placed its metal essence inside a wooden frame and hung it next to my first arm of plastic. Someday I will build a full-scale maintenance robot and have it take good care when dusting them each day, as we enter the first decade of home robotics. □

# FUTURE



# The Beginning Of A New Era: The Working Robots

By Terry Costlow, Assistant Editor

One of the most visible areas of robotic research today is in the field of promotional robots. To attract attention at their booths at computer, electronic or other types of shows, many businesses are hiring robots to be their mascots during the event.

Like See-Threepio and R2-D2, the robots who sparked the imagination of the public, these promotional robots walk, talk and pick things up. But unlike the *Star Wars'* heroes, who were men in robot outfits, the promotional machines have electronic insides.

Although their creators don't claim to have creations that can clean up the house or operate without constant monitoring, they do claim one thing. Their robots are fun.

## A SHOW BIZ KID



"We never have a problem with people not paying attention to Orion. He acts like a three-year-old. And all his costumes have a furry, friendly feeling," says Terry Palmer, "mother" of one of the first promotional robots.

The short, bubble-headed robot travels around the country touring the shows with his creators, Ron and Terry Palmer. At the appearances, the mechanical midget wears any of 20 costumes, ranging from a railroad engineer to Uncle Sam to a superhero. "My favorite is the Rhinestone Cowboy. He wears a hat, six guns and a badge made of LEDs," Palmer says. The costumes are chosen by the client, who picks the clothes he feels most fit the image of his product.

Once people see the little robot and stop to look at him, a bit of show business is needed to keep them from leaving after a quick glance.

"Orion will walk up to someone, read their nametag and start talking to them. As long as people see that the robot is actually looking at them, that's what gets them. Orion will start asking them questions about things they're wearing, or ask a girl for a dance or a kiss. Very few refuse," Palmer explains.

If a female gives the robot a kiss on the dome, the antenna that protrudes from his head shoots up and he begins to spin around uncontrollably. If she wants to dance, the chivalrous robot raises his antenna so he is taller than his partner. He then switches on a tape of *Star Wars* or another of his favorites.

One question those at the shows often ask Orion is the source of his intelligence. To those who ask how he works, he often answers "Very well." Ask how he operates and "I'm not a surgeon" is a probable parry. "I've got wheels" is a comeback for those who ask how he runs.

This personality is what the Palmers feel sets Orion apart from the other robots used for promotional purposes.

"He tends to be a little bit more human. He has feelings. If someone doesn't talk to him, he acts hurt and asks them why they don't like him," Terry says.

As the Palmers work a show, Orion passes out brochures and contest coupons, then takes them back and drops the completed entries into the bin. When it comes time to pick the winner, Orion selects the card, turning away and slinking an arm back to fish for a card.

Although he'll give things away, Orion isn't much of a salesman. "We try not to sell. People get intimidated if a robot tries to sell them something," Terry says.

During the shows, the robot must keep a friendly demeanor to avoid antagonizing potential customers. But on at least one occasion, he let some antagonism come out. A man at a bank show in Atlanta was giving the robot a bad time, so Orion asked for his tie for a trick. The man complied. The feisty robot then wheeled over to a paper shredder and fed the tie through it. Everyone, including the man who lost the tie, thought is was hilarious, the Palmers recall.

Traveling around the country with a robot sometimes taxes the imagination of Orion's caretakers. At a show in New York, a lady began attacking the robot while it was sitting out of commission in a stairwell. She pushed Orion down the stairs, breaking one of his arms. After watching the security guards escort her out, the Palmers had to think fast to continue working the show. Orion finished the appearance with his arm in a sling.

But through most of the robot's three years of traveling around the country, he has been pretty durable. Orion has been in 38 states since he was "born" in January, 1975.

Orion was created after 18 months of labor by Ron Palmer. During that development period, they invested about $7,000 in parts. Friends and relatives were in 100 percent agreement when they heard of the Palmers plans to build a robot and travel around the country showing it.

"At first everyone said 'You're crazy. You've got to work normal jobs'," Terry recalls, laughing. Once the robot was finished, they formed Digi-Tech, Inc., working at first out of their home in Metuchen, New Jersey. Then they worked any type of show they could, from grand openings to children's birthday parties. But after a few kids attacked Orion with skateboards or poured punch and soda over the robot, they decided to go for shows with more sedate crowds.

During those early years, touring with their new toy was a break-even proposition. "1978 was the first year we really made any money," Terry Says. But during that period when they were developing the robot and his personality while they

traveled around the country with their money-making package of lights and circuits, the Palmers developed quite an affection for the little creature.

"He's like a son to me. The first day our daughter went to school, she told her teacher she had a robot for a brother. The next day I had to take Orion in for the teacher and the class to see," Terry says.

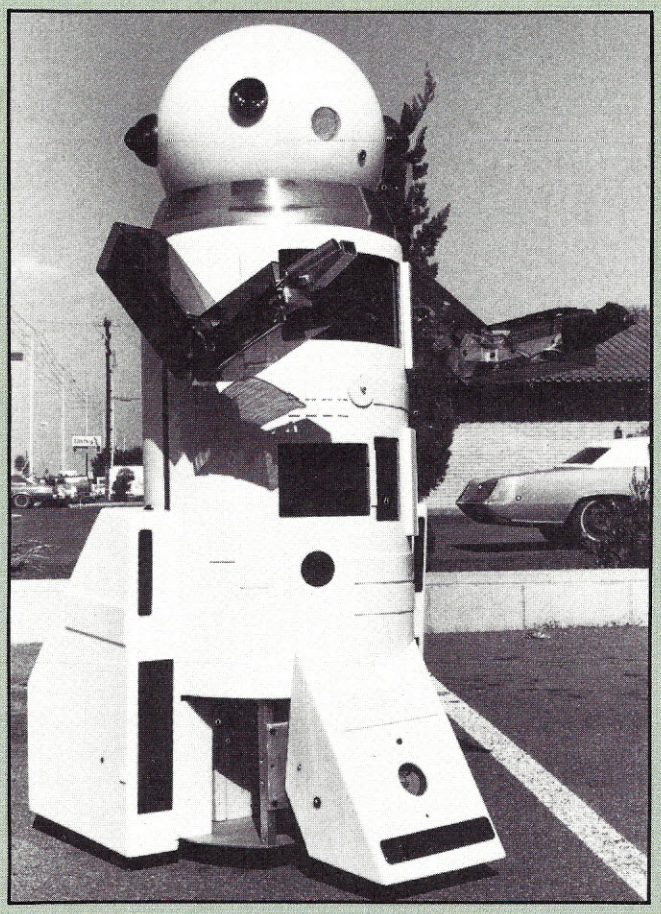
Sometime early in the 1980s, Orion will get a chance to do whatever it is robots do when they have a lot of spare time. "We're going to take him off the market like a movie," Terry says. After being put on an extended vacation, Orion will sometimes be brought out of retirement. For right now, the Palmers are uncertain what they will do once they quit using the popular robot.

Terry Palmer returns to the analogy of movies when she is asked how Orion is operated. "We don't like to tell people how he is controlled. We like to use Orion on the image that he's magical, a kind of Walt Disney thing," Terry says, declining to reveal the secret of her mechanical traveling companion.

## RESEARCHING THE NEXT MICKEY MOUSE

Until last summer, Ray Raymond had little interest in robots, instead concentrating his efforts toward his business of making table tops for restaurants. But then he met Gene Beley, of Android Amusement Corporation, who was looking for a partner with the technical ability to build a robot. The two struck a bond together, spending most of their nights and weekends putting together a robot.

The result is a 300-pound, four-foot robot simply called AG-1. It took them about four months to put their cylindrical white robot together. It also took an estimated $38,000.



"If you're addicted to robots, you need a constant supply of money," Raymond says. Addiction is an apt term for his time consuming interest in robots. He has read several books about the history of robots, along with many about their current development. "This is almost like a narcotic for me. I want to work on it all the time."

Although AG-1 is out on the show circuit, much of the emphasis of Android Amusement is geared towards research. Raymond is working on AG-2, a cellular robot that will have interchangeable body segments. When he finishes it, he plans to go on to building a third model.

"My feeling at the completion of AG-1 was frustration. I was disgusted with it. I'm satisfied with AG-2, but I just want to give it to Gene and start work on another one," the technician says.

Beley is in charge of promoting the robot and lining up the work. Getting clients to spend $1,200 per day on a robot in addition to their costs of putting together a booth for a show is sometimes difficult for him.

"Many of them want to use the robot for free. They say they're doing us a favor by letting us work with them," Beley says. Like most businessmen who have close to $40,000 invested in a product, Beley declines. Another problem of getting clients is to arrange a demonstration for potential customers. "I met one guy who wouldn't even come down to the parking lot for a demonstration. He wanted me to bring the robot upstairs to his office. That thing weighs 300 pounds," he says, laughing.

Weight is an important factor in the construction of the robots. To move the 300-pound robot over uneven convention hall floors, Raymond went through several motor configurations. He finally ended up putting in some machine motor wheel packages powered by gel cells. AG-2 uses the same motors, allowing the 200-pound model to move much faster.

Another important consideration is durability. To achieve this, they built the body of fiberglass.

"It has to be extremely durable to survive in shows because you get into a crowd where people are touching it and trying to get some interaction with it. And then some kid will come up and kick it," Raymond says.

"The easiest way to test the electronics is to give it to a non-technician. He'll plug in the wrong thing or something. Then I have to see what he did to destroy it," he continues.

Picking an appearance that will make everyone happy also took some time. "We picked this design because it is toylike, it's not intimidating. We don't want to make robots that are taller than any individual. The robot also has to be more than an attention getter. We're trying to develop a robot that ties into the advertising instead of just being a 'See the robot' type of thing," Beley says.

To achieve this they put a color TV in the chest of AG-1. With AG-2, the different cells allow the robot to carry any of several components, including TVs, computers, games or a ticker tape machine.

They decided against using plenty of lights, dials and gauges to give it a futuristic, mechanical look.

"A lot of people want to see gauges and common things. But we want to keep the integrity of the robot. If we use meters in the robot, we won't use dials. We won't even use numeric LEDs because they're too common. We'll put in the lights," Raymond explains.

After considering all these things for the construction of the first robot, Beley and Raymond thought they would be all ready for their first show. But problems began to arise when the robot shorted out as they put on the finishing touches a few hours before the show was supposed to start. Beley spent the night chewing his fingernails waiting for a store to open so he could get the part. Once they got it and took the robot to the show, everything worked fine. Then came the high point of the show. Los Angeles Mayor Tom Bradley walked in. AG-1 promptly broke down.

"Our first show was a disaster. It was quite a lesson. Since then we've been paying our dues out in rural areas," Beley explains. He has now regained enough confidence to work shows in Las Vegas and other large cities. But the opening night fiasco prompted a policy for the future.

"Robots should be field tested. Shows are the roughest places to run them because when something happens, it just

happens, right in front of everyone," Raymond explains.

For the future, the pair sees much happening in the field of robotics, with competition in the promotional field increasing. They plan to keep creating different models in order to keep in step with the competition. Beley feels the payoffs may be high.

"The robot may become the Mickey Mouse of the space age, and it's just going to be a matter of whose robot clicks," he says.

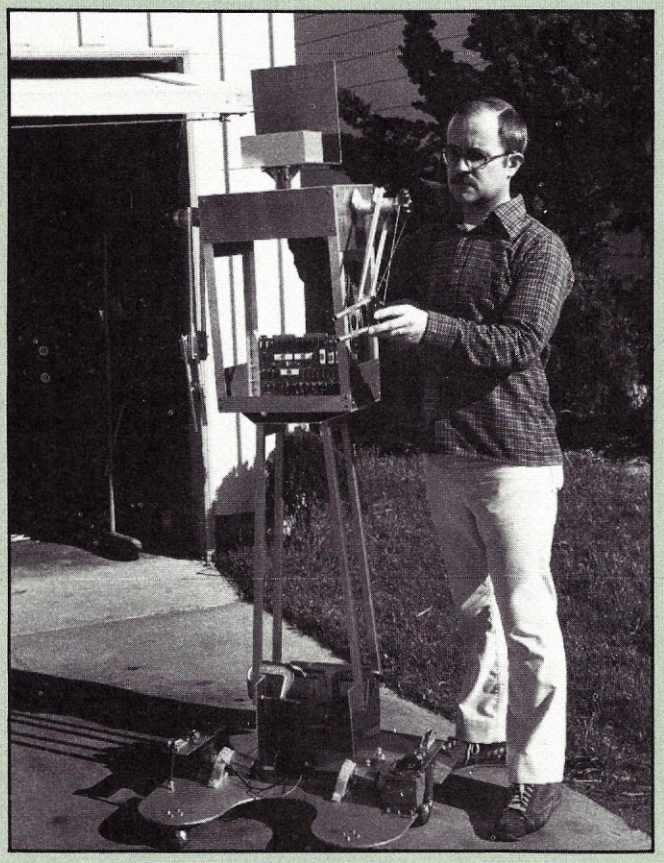
## AN INVENTOR'S DREAM

Getting started in the robotics field of promotions can be a costly, tedious affair. Tom Carroll, an engineer living in Long Beach, California, has found that out. Despite the fact that he may never get any financial return, he has bought parts with a retail value of about $30,000.

Carroll first became enchanted with robots when he read Isaac Asimov's *I Robot* while he was in high school. The book inspired him to build his own model, a robot he now describes as "a 400-pound plywood monster." That 1957 version contained parts from cars and a juke box, along with a tape recorder and lots of flashing lights. Although it moved slowly and could only carry on a prerecorded conversation, it was quite a hit in Tom's small high school in North Carolina.

After several years of reading all he could about all types of robots, Carroll recently began working to realize his 20-year dream of owning one. Last June, he joined the ranks of the promotional robot builders, beginning work on a six-foot fiberglass model named Colossus.

The name came from the ancient statue in Rhodes, which stood in roughly the same stance as his robot. His design was chosen simply because it was "practical." Although many people with promotional robots keep theirs small and cute, Carroll likes his human-sized design.



"Mine's bigger than the others because I want people to see it. When someone sees something that's six feet high moving across the floor, they're going want to take a look at it," the 36-year-old says.

Since beginning production last summer, Carroll has logged in about 1,400 hours of labor, all meticulously recorded in a small notebook. His family doesn't mind his spending that much time on his hobby. But how can a man with a wife and three children buy $30,000 worth of equipment?

"I hit the surplus places like you wouldn't believe. And I've really been collecting for this for 10 years. I've been waiting for the time I could build a robot. Now with the advent of computers and the lowering of costs, it's become feasible for me to put my plans into effect," Carroll says.

Although he first hoped to finish Colossus in January, 1979, Carroll now expects to have the silver and black robot finished in June. One of the reasons he isn't proceeding rapidly is that he wants everything to be done perfectly.

The fiberglass body molds are one example. Unlike other roboticists, Carroll isn't using available parts for the body of Colossus. But to have a company make the custom molds and the body became too expensive. So he is making the curving body molds himself.

"It's taken me hundreds of hours to make the molds. I could do them faster, but I want something that looks perfect. I don't want anybody to look at my robot and say it's a pile of junk," he says emphatically.

This penchant for perfection is what Carroll feels will set his robot apart from the others, making clients choose his over those of his competitors.

"Mine looks like a robot, at least in the public mind's eye. It has a sophisticated control mechanism and a professional appearance. It was designed as a robot from the start. I'm not using any dryer hose arms. Mine also has unique body motions, it bends at the waist and ankles," he explains.

The unusual body motions allow the robot to lean over at a 10 degree angle when it is speaking to shorter persons. In order to keep its balance and avoid falling on its red plexiglass face, the robot also bends backwards at the ankles to offset the weight of the body.

Power from the robot will be supplied by a standard car battery. While others shun this idea because of the problems of transporting a heavy acid battery, Carroll plans to simply buy a new battery when he goes somewhere.

The motors will sit in the 28 by 29 inch base beside the battery. Because most of the electronics are also in the base, Colossus only weighs about 50 pounds from the ankles up. The motor system was developed with help from the closest thing Carroll has to a partner, his brother Jim, who lives in North Carolina.

"He said my design was flimsy. We worked together over the phone and developed another one. Now we've got a pretty good system," he says.

Carroll is also proud of his highly imaginative control system. But he doesn't want to divulge it, feeling that others may attempt to copy the idea. He doesn't hide the fact that his robot has no intelligence built in, although it does carry an Intel SB-80/10.

Like the rest of the robot, it was well-planned before construction began. During his 15 years as a satellite systems engineer at Rockwell, Carroll has learned to test his designs before going into production.

"I've saved myself considerable time and several thousand dollars by doing my engineering on paper," the inventor says. "I'd also advise anyone who wants to go into this that they must know machining before starting. It would have cost me $100,000 to have some of the work done if I didn't have my own drill press and lathe."

Although he does much of the work himself, he has drafted some of his friends to do technical work he can't do. They made some printed circuit boards for him, but even their reduced labor costs became expensive. Carroll's problem is that there are too many six centimeter parts in a six-foot robot to do everything himself.

While he is working on the robot, Carroll gets much moral support from his family and friends. His wife is "very understanding" about his time-consuming hobby. And his

sons really began to take an interest when the motors were placed on the metal base and they could ride it up and down the sidewalk.

"The neighbors are always coming by and asking 'How's Colossus?' And the kids in the neighborhood are all excited about it. There's no way I can quit. I've got too many people who want to see it and some who want to rent it," he says.

Kids also come around to see one of his past creations, an eight-foot high spaceship on wheels, complete with a mock telephone, lights and plenty of switches.

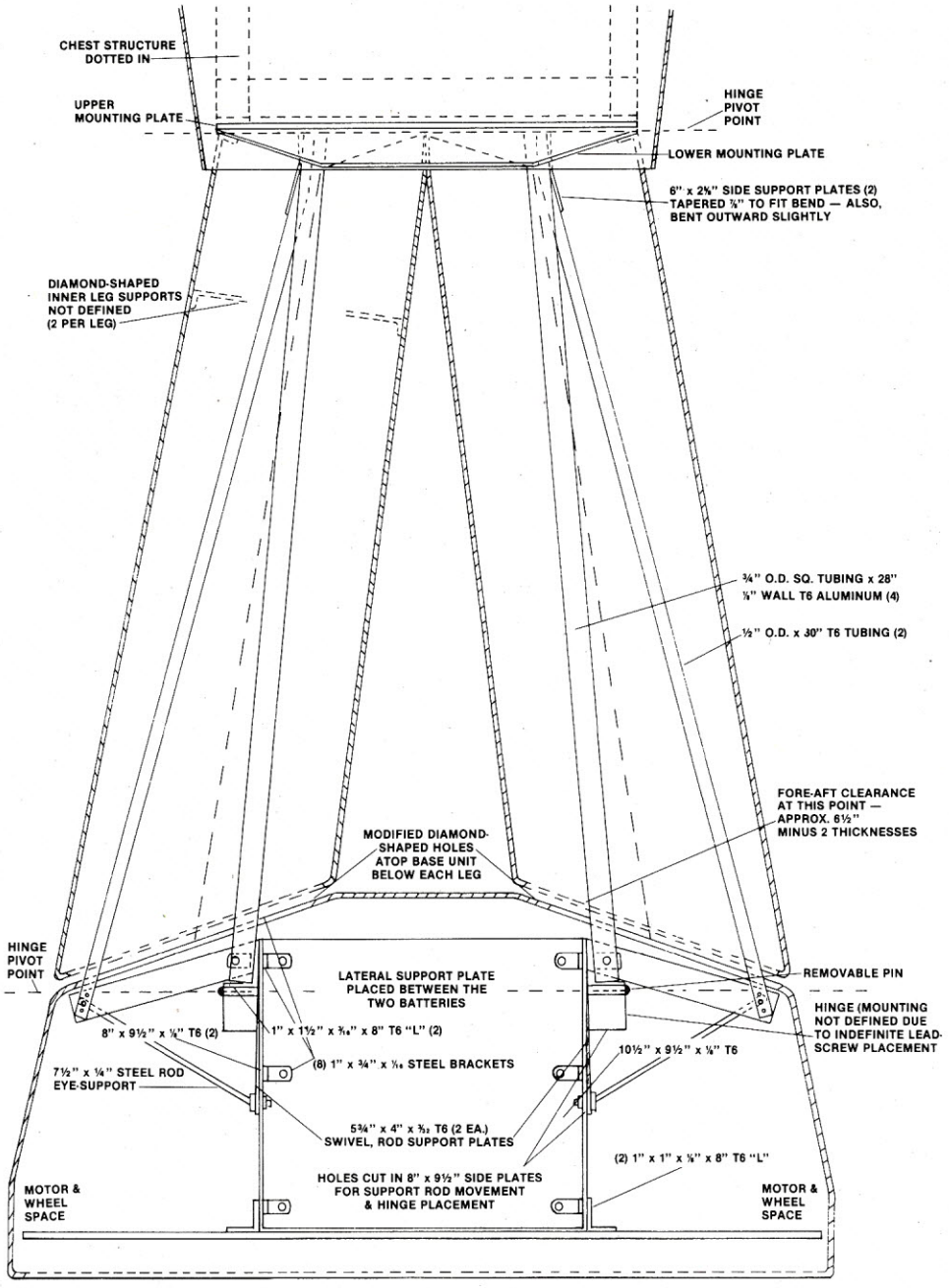
"I always wanted a spaceship when I was a kid, so I thought I'd build one for my kids. I've had kids come by here and say they've heard about the spaceship at school. And my kids don't even know them," he chuckles.

This type of interest in technology makes Carroll feel that people will want to see robots at the shows. Although he's sure Colossus will be a hit, he's still uncertain about his future as a robot operator. "I'd dearly love to go into showing my robot full time," he says. "I'd possibly like to go into it next year. But I've got a family to support. I have to make some money."

Whatever he ends up doing with Colossus, Carroll will have at least fulfilled a dream. And he undoubtedly will make another when he feels technology has made this one obsolete. One of his goals is to have Rockwell go into robotic research so he can combine his work and his love. He feels the time is right for widespread research in robotics.

"I think we're riding on a wave of technological enchantment with *Star Wars*, computer games and everything. Consequently, people are going to be very, very interested in robots," Carroll says.□

*The owners of Orion can be contacted at Digi-Tech, Inc., 58 Van Buren Avenue, Metuchen, NJ 08840. The address of Android Amusement Corporation is 2324 Lenta Lane, Arcadia, CA 91006. Tom Carroll can be contacted at 7025 El Paseo Street, Long Beach, CA 90815.*




**Figue 1. Leg Structure (Front View).**

# A Robot That Does Nothing

Building a robot used to be limited to those lucky few with a well-equipped shop and a good source of mechanical parts. But now, even the experimenter with modest tools and resources can assemble his own device with a variety of kits.

After designing, testing and rebuilding robots for two years, Lour Control has written a builder's manual for a android type robot. For those who lack the time or desire to build their own robot from scratch, Lour Control offers the robot in either kit or preassembled form.

Despite the assembly line appearance, each robot is intended to acquire a personality all its own. The robot doesn't have a name, but is simply called by its series classification — et-2 (for experimental transmobile unit with 2 drive motors). Actually et-2 isn't a robot in the usual sense of the word but is a "robot shell" that requires the addition of controls by the builder to become functional. Those controls, whether a simple logic circuit or a full blown microcomputer, interface with circuits already on et-2 that convert digital signals into robotic reflex. Thus et-2 is capable of growing as the knowledge and experience of the builder grows. Its potential is limited only by the ingenuity of the person adding the controls.

The secret behind et-2 is its unusual design. Foregoing exotic technology and custom made hardware, et-2 uses modular construction and off the shelf parts that, when combined, make a device that is surprisingly sophisticated and affordable.

Originally conceived as a laboratory device, et-2 has now been adapted to become a household pet. At a little less than two feet high and 13 inches wide, its cylindrical shell fits in either a home or a lab. For home use, et-2 travels with enough power to move easily on most carpeting, but without enough force to knock over furniture.

To avoid damage on most encounters, the shell's lower tier is ringed with four mechanical bumpers. Each bumper is actually an independent dual-pole, dual-throw switch that can be tied directly into whatever controls are added by the experimenter. Then the proper avoidance response can be activated when any of the bumper switches closes. The bumpers are intended to be used either exclusively in an environment especially limited to insure their operation on contact, or as a backup to more elaborate sensors such as an ultrasonic system. Although ultrasonics may seem to be beyond most home kit builders, they use the same principles already used in home intrusion detectors.

To get out of tight spots, et-2 incorporates a proven mode of systems built around two diametrically opposed drive wheels, each with its own motor, power train and control circuitry. The rear section is mounted on a single heavy-duty caster. This arrangement not only gives et-2 a very short turning radius, since it moves in a tractor-like fashion, but also makes controlling the shell much easier.

Of primary importance is the fact that the construction is simple. Few tools are needed. The parts are also easy to obtain. For example, the drive wheels (six-inch lawnmower tires), as well as the caster, can be found in most hardware stores.

The power motors are also easy to find. Two standard windshield wiper motors, which are available at most auto dealerships or parts stores, are used to power et-2. Though new or rebuilt motors aren't cheap, their price is a fraction of what similar industrial motors usually cost. Mounted on the lower tier, each motor powers its own drive wheel via a miter

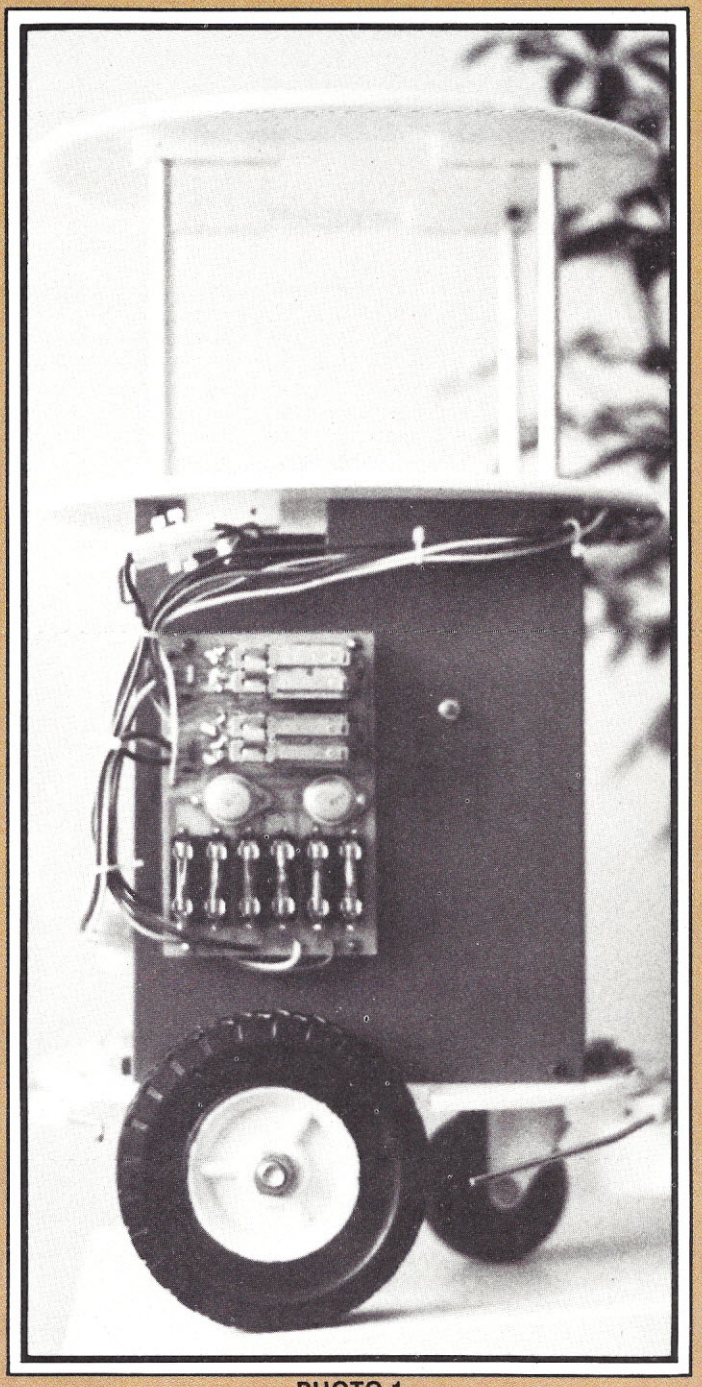


**PHOTO 1**

# Until Controls Are Added

By
Erik Lindholm
*Lour Control*
*1822 Largo Ct.*
*Schaumburg, IL 60194*

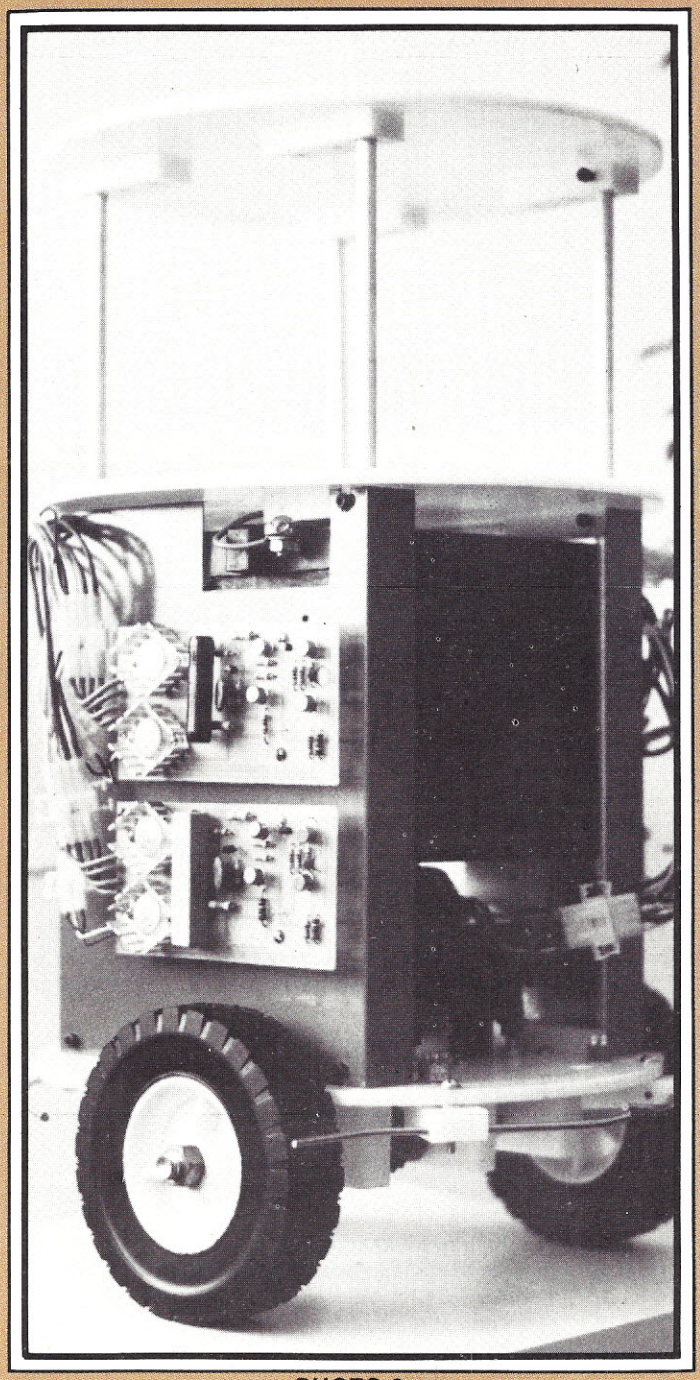


**PHOTO 2**

gear affixed to its output shaft. This unites with a similar gear on the axle itself.

Both motors are controlled independently through their own transistor drive circuitry and reversing relay. Applying a constant 50 ma, +5 volt signal to the input of each of the two drive circuits causes the motors to energize and push et-2 forward. Turning is accomplished by activating one of the reversing relays with a similar +5 volt signal. This reverses the motor's polarity and the direction of its rotation, causing et-2 to spin around, practically on its own axis.

The axle mounts are made of Delrin, a nylon-like plastic that is commonly used as a bearing material. The rest of the shell is made of a PVC material similar to that used to make record albums. Originally, Delrin was to be used for the entire shell. But it was discovered that Delrin dissolves quite quickly when it comes in contact with the acid from the 12-volt motorcycle battery carried on board. The PVC material is immune to the acid.

PVC can also be easily cut and drilled with regular hand power tools. Though these particular plastics are specified, the builder can use a number of materials, from plywood to aluminum. It's the design that makes et-2, not the materials.

The only parts of et-2 not made of Delrin or PVC are the four aluminum rods separating the disks, and the sheet metal side panels, which support the circuitry and 12-volt lead/acid battery. The battery not only powers the drive system, but can also be used by the control sensors or the mechanical hardware. That power can be tapped directly off the battery or via two regulated power ports located on the relay board. Each port is capable of supplying +5 volts of up to one amp, perfect for TTL or CMOS circuits.

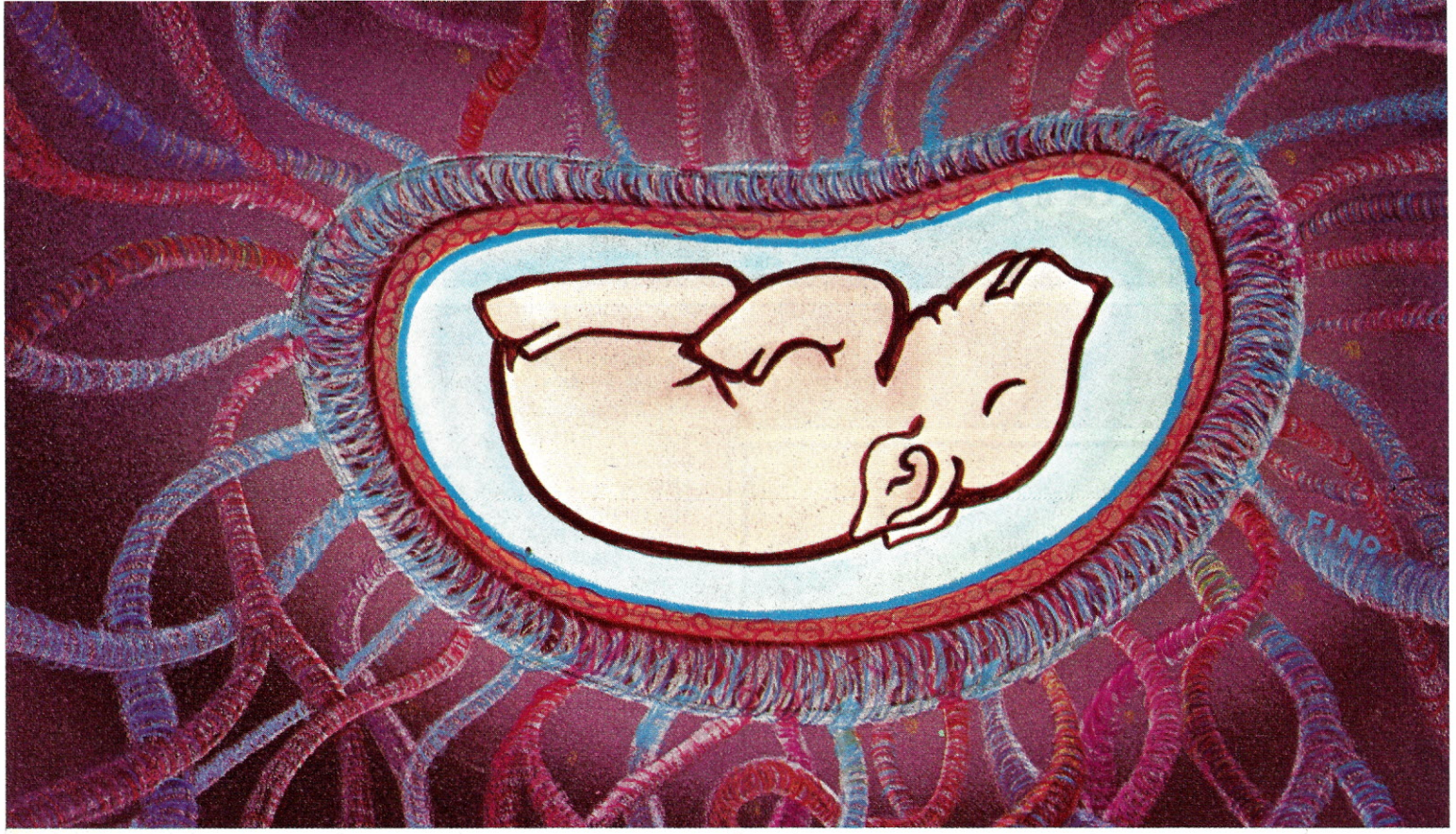
At present, et-2 is limited to pushing objects or exploring its environment. The kits and assembled robots are made complete with bolts for mounting a manipulator on the front of the shell. But even with the addition of the manipulator, the robot is only as good as its intelligence permits it to be.

While et-2 will probably never answer the door or make a meal, it can be useful for an experimenter. The prototype can be used to test program controls or hardware that may be incorporated in future robot designs. et-2 can, with a few modifications, be taught to scoop up a newspaper, fetch slippers or carry drinks or hor d'ouvres. With the addition of remote alarm activations or an infrared camera, it can even become a roving security system.

The main point is that et-2 is limited only by the builder's imagination. The selection of controls available is mind boggling. One of the wide variety of microprocessors currently being tested at Lour headquarters is RCA's 1802 Cosmac chip. Because the chip is of the CMOS design, it is low in power consumption, an important consideration.

Still, it doesn't take microprocessors to get et-2 moving. The builder's manual describes a simple circuit requiring only seven ICs that, when tied into et-2's bumpers, stop the robot and turn it away from any obstruction it encounters. As the experimenter becomes familiar with the workings of the robot, he can expand et-2 as quickly or as leisurely as he desires.

The manual, available for $15, explains step by step fabrication and lists the necessary tools and materials. For information, contact Lour Control at 1822 Largo Court, Schaumburg, Illinois 60194.□



# Gestation Calculations

By Jim Schreier, Associate Editor

Any table requiring a sliding finger or, worse yet, a ruler, deserves to be transferred to your microcomputer. That this table contains gestation period for mares, cows, ewes and sows is of secondary importance. Of primary concern, in my opinion, is to have an accurate method of calculating a given number of days, self-adjusting to the next year. As such it should only take a few moments to adjust the program for guppies or pet white mice. The following may be of assistance.

The gestation variables (lines 70-120) are set by selecting the desired animal. Misspelling the animal's name (and thus not matching the given string) cannot produce a variable. The lack of a variable is caught in an error trap found as a GOSUB routine in lines 1100-1170. The error trap is related to the variable and not the string in question. This makes simpler conversion to non-string BASICs, including tiny BASICs.

The gestation variable is added to two figures, the day of the month and the accumulated days of completed months, line 150. The accumulated days of completed months are drawn from the DATA statement, line 1300. If a leap year should enter into the calculations, the program may be altered in one of two ways. First, the DATA statement may be altered to read DATA 0,31,59. . .(etc.) to DATA 0,31,60. . . (etc.). The second option is to change line 640 to read: LET B = (T-E).

The total number of days added (variable T, line 150) may exceed 365, a complete year. If T is less than 365, the total days involved are filtered through a programming sieve, lines 200-600, which readjusts the new month and day. If, on the other hand, the total days are greater than 365, 365 is subtracted from the variable T, the year is increased by 1; and the filtering process is activated, lines 800-830.

A few comments about the subroutine, line 1000. The ASCII control characters for my CRT clear are 26 and 2. The statements PRINT CHR$(26) and PRINT CHR$(2) may be left out. Instead you may wish to use 1000 FOR X9 = 1 to X:PRINT:NEXT X9. The variable X would be the number of lines supported by your terminal or printer.

This program was written using the SWTPC 8K BASICs, v 2.0, 2.2 or 2.3; or Disk BASIC/FLEX™ v 3.0. LINE, used in statement 10, may be omitted if not supported by your BASIC.

Meanwhile, back at the ranch, start programming those various gestation tables. After all, your micro was made for pragmatic solutions!□

| | |
|---|---|
| A$ | month's name in the sieve |
| B | the new day within the new month |
| D | service day |
| E | "offset" days within month |
| G$ | variable to commence a re-run or end of program |
| M | month of service entered as 01 to 12 |
| S | given gestation length |
| T | total of days into a given year |
| T$ | specific animal |
| X9 | temporary variable |
| Y | last two digits of the year of service |
| Z | the DATA read variable using X |

**Table 1. Variables Used in Gestation Calculations**



```
0010 GOSUB 1000:LINE=120:PRINT
0020 PRINT TAB(20);"GESTATION CACULATIONS"
0030 PRINT TAB(16);"FOR MARES, COWS, EWES AND SOWS"
0040 PRINT :FORX9=16 TO 44
0050 PRINT TAB(16);"*";:NEXTX9:PRINT:GOTO 56
0055 RESTORE
0056 PRINT :PRINT
0059 REM PROGRAM DOES NOT ADJUST FOR LEAP YEAR
0060 INPUT "DATE OF SERVICE [ MM,DD,YY ]",M,D,Y
0066 PRINT :PRINT
0070 PRINT TAB(4);"SELECT SERVICE TYPE:"
0080 INPUT "MARES, COWS, EWES OR SOWS",T$
0090 IF T$="MARES" THEN S=340
0100 IF T$="COWS" THEN S=283
0110 IF T$="EWES" THEN S=150
0120 IF T$="SOWS" THEN S=112
0130 GOSUB 1100
0140 FOR Z=1 TO M:READ X:NEXT Z
0150 LET T=X+D+S
0160 IF T>365 THEN 800
0200 IF T>31 THEN 230
0210 LET A$="JANUARY":E=0
0220 GOTO 600
0230 IF T>59 THEN 260
0240 LET A$="FEBRUARY":E=31
0250 GOTO 600
0260 IF T>90 THEN 290
0270 LET A$="MARCH":E=59
0280 GOTO 600
0290 IF T>120 THEN 320
0300 LET A$="APRIL":E=90
0310 GOTO 600
0320 IF T>151 THEN 350
0330 LET A$="MAY":E=120
0340 GOTO 600
0350 IF T>181 THEN 380
0360 LET A$="JUNE":E=151
0370 GOTO 600
0380 IF T>212 THEN 410
0390 LET A$="JULY":E=181
0400 GOTO 600
0410 IF T>243 THEN 440
0420 LET A$="AUGUST":E=212
0430 GOTO 600
0440 IF T>273 THEN 470
0450 LET A$="SEPTEMBER":E=243
0460 GOTO 600
0470 IF T> 304 THEN 500
0480 LET A$="OCTOBER":E=273
0490 GOTO 600
0500 IF T>334 THEN 530
0510 LET A$="NOVEMBER":E=304
0520 GOTO 600
0530 LET A$="DECEMBER":E= 334

0600 PRINT
0610 GOSUB 1000:PRINT
0620 PRINT TAB(8);"THE GESTATION OF ";T$;" IS ";S;"DAYS"
0625 PRINT
0630 PRINT TAB(11);"WITH SERVICE OCCURING ";M;"/ ";D
0635 PRINT
0640 LET B=(T-E)-1
0650 PRINT TAB(8);T$;" SHOULD BEAR: ";A$;" ";B;", 19";Y
0700 FOR X9=1TO5:PRINT:NEXTX9
0710 INPUT "WOULD YOU LIKE TO RE-CACULATE, [ Y ] OR [ N ]",G$
0715 IF G$="N" THEN 790
0720 IF G$="Y" THEN GOSUB 1000
0730 GOTO 55
0790 END
0800 REM NEW YEAR
0810 IF T>365 THEN Y=Y+1
0820 IF T>365 THEN T=T-365
0830 GOTO 200
0990 END
1000 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
1010 RETURN
1100 IF S<> 340 THEN 1120
1110 RETURN
1120 IF S<>283 THEN 1140
1130 RETURN
1140 IF S<> 150 THEN 1160
1150 RETURN
1160 IF S<> 112 THEN 1200
1170 RETURN
1200 PRINT :PRINTTAB(13);"> INPUT ERROR. PLEASE RE-SELECT"
1210 PRINT :GOTO 70
1220 RETURN
1300 DATA 0,31,59,90,120,151,181,212,243,273,304,334
```

# Workers Who Really Spend Their Lives On The Job

# Industrial Robots

By Betsy Gilbert

There's a new worker on the assembly line these days. He doesn't come in late, doesn't call in sick, never breaks for lunch and rarely makes mistakes. So what is he, you ask — some kind of robot?

Some kind of robot is exactly what this worker is, but it's probably not the kind you have in mind. All of us who saw *Star Wars* or any of the 1950's sci-fi movies have a definite image of a robot: a human-like piece of machinery which walks rather stiffly and speaks in an unearthly voice. Right? Wrong.

In reality, robots bear little resemblance to the image movie makers have given us. By commonly-accepted definition, a robot is a self-contained, teachable, program-controlled manipulator. So much for R2-D2, C3PO and the rest.

The modern-day robot, though decidedly non-human in appearance, is capable of performing a number of tasks traditionally performed by human workers. Moreover, since its introduction to industry over a decade ago, the robot has been taking on the jobs that the factory worker finds tedious and even dangerous.

As a solution to the problem of rapid turnover in factory labor caused by the monotonous nature of some jobs, a number of companies began experimenting with robots during the 1960s and early 70s. Workers performing low-level jobs were replaced on the assembly line with robots and the results caused manufacturers to take a more serious look at the new frontier of robotics. Many companies who now utilize robots on their production lines have been able to create new jobs for the replaced workers in the fields of design, planning, programming, maintenance, supervision and management.

As previously mentioned, the industrial robot doesn't fit the description of the humanoids science fiction has given us. Rather than a body with arms and legs, the robot is actually a single arm with up to six axes of motion. It is stationary, lacking wheels which might allow movement from its workplace.

The variety of robots on the current market is fairly large, offering different load capacities, programs, motion axes and arm configurations to meet the specific needs of the potential customer. Prices vary as well, ranging from a few thousand dollars for a limited, pick-and-place model to almost $100,000 for a highly sophisticated, computer controlled robot.

Unimation, Inc. and Cincinnati Milicron are leaders in a field of some 26 U.S. manufacturers who have marketed over 2,500 robots to American industry.

Unimation, a pioneer in the field of robotics, recently introduced its latest model to a crowd of eagerly awaiting industrial representatives at the Third National Industrial Robot Conference and Exposition in Chicago. It is a small, lightweight, highly precise robot that can work side-by-side with human workers. PUMA (Programmable Universal Manipulator for Assembly) has five axes of motion and uses electric servos as drivers. It requires about as much working room as a human and has a weight capacity of about eight pounds.

Unimation's Unimate model is a turret-on-the-box design and has from three to six degrees of motion. The arm's movements are hydraulically actuated, while special-purpose hands available for this model may be pneumatic. The robot is programmed with a lead-through technique, in which the programmer uses controls to make it move through the desired motion sequence. The Unimate's solid-state memory has the capacity for up to 1,024 steps.

The CH6 from Cincinnati Milicron is a more sophisticated robot than the Unimate, featuring a jointed arm with six axes of freedom. Actuation is totally hydraulic and the model's minicomputer control allows it to work on an object while that object is moving along a conveyor belt.

Simpler robots are available from a number of U.S. companies. The Auto-Mate and Auto-Place, both listing at a base price of $9,000, are limited-sequence, pick-and-place units. Auto-Mate is turret-mounted and pneumatically actuated, with a weight capacity of 10 pounds. The Auto-Place is a similar model, pneumatically actuated with a 24-step air logic programmer. Weight capacity varies from 10 to 30 pounds.

Falling in the mid-range of robot sophistication is a unit called the Prab, which has a greater capacity than the others — 50 pounds — but is operated by a similarly simple program. The hydraulically actuated Prab has four motion axes and is programmed by setting tabs on a rotating drum. As the drum turns, the tabs trip switches to activate the robot.

There is no denying that robots have been successfully integrated into industry. General Motors plans to put 10 robots on its assembly line — among them the PUME — during the next year. They will be used primarily for spot welding jobs. Chrysler Corporation is already utilizing 36 robots to perform virtually all of its spot welding in the assembly operations of its new compact cars.

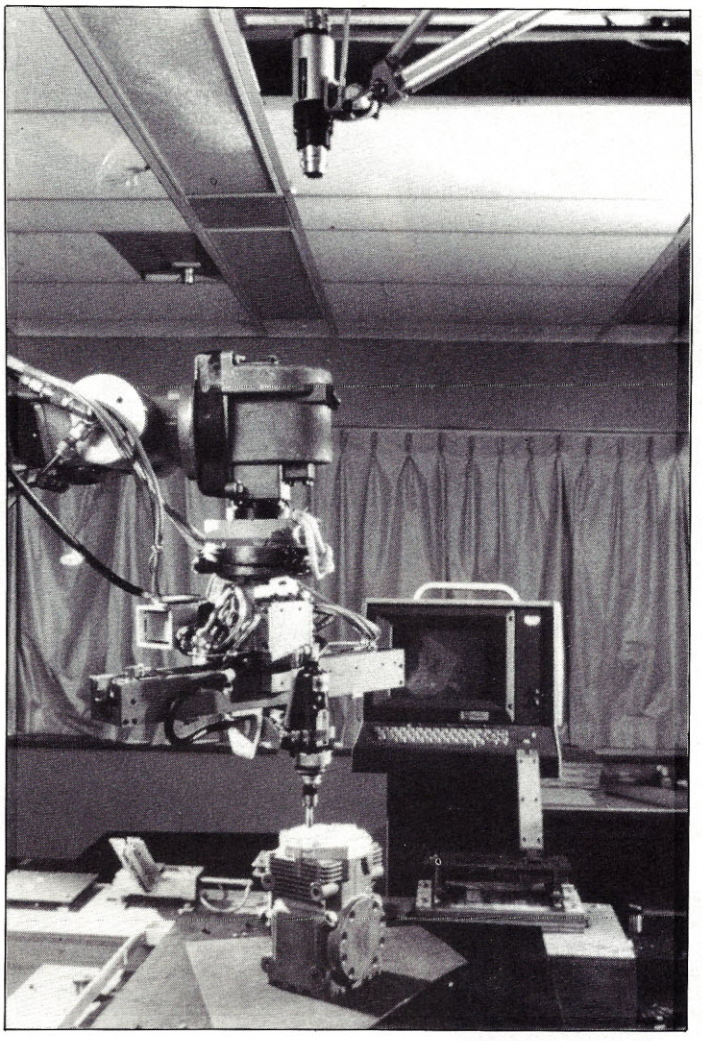


**PHOTO 1 A Unimate 2000B manipulator is being used here to bolt the cylinder head onto a small air compressor. A General Electric TN2200 TV camera at the top of the picture locates the compressor, which is resting on a compliant table. The manipulator first places the cylinder head on the compressor body. Then it picks up the pneumatic torque wrench as shown and uses it to place eight bolts into the compressor and tighten them down. A storage tube display at the rear shows the camera's view of the work area.**

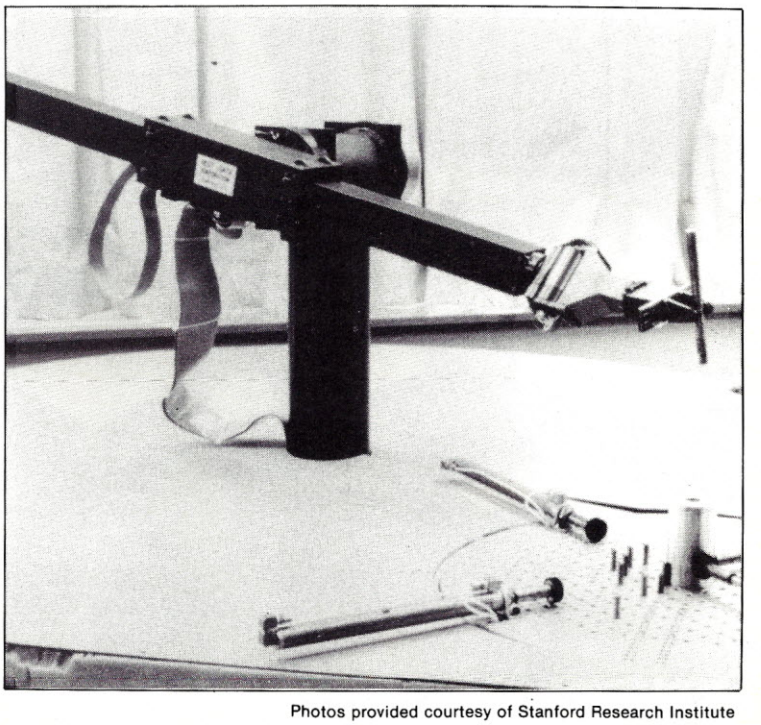


**PHOTO 2 This six-jointed "Stanford" arm, powered by electric motors, was designed by Victor Scheinman for his thesis while he was at Stanford University's Artificial Intelligence Laboratory. It is currently one of the most popular manipulator designs for laboratory experiments.**

Photos provided courtesy of Stanford Research Institute

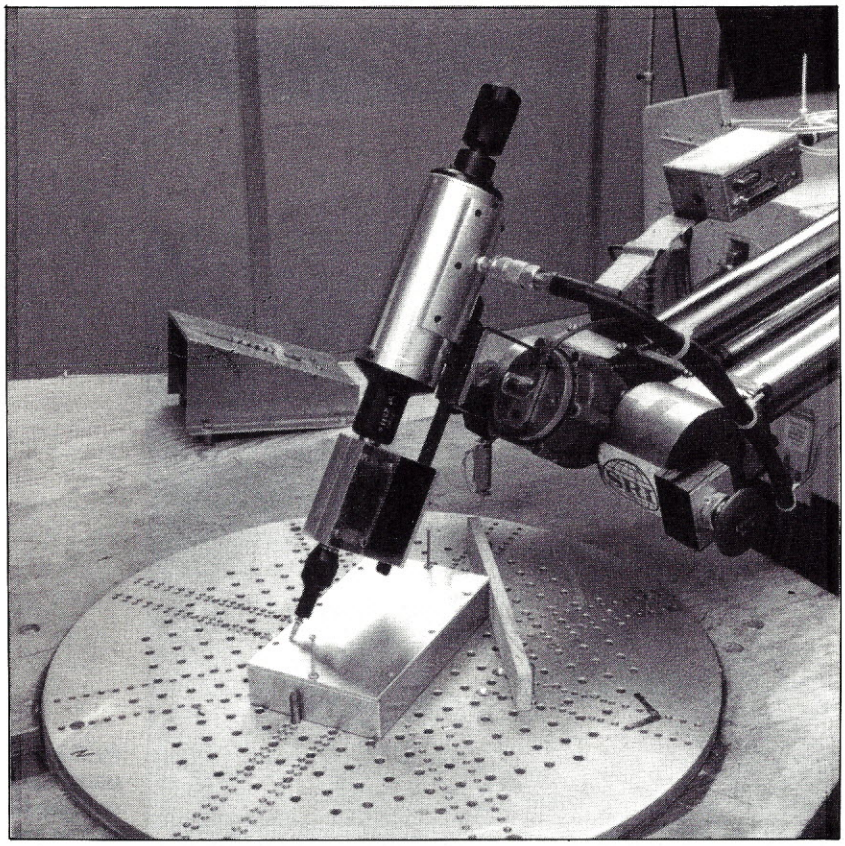


**PHOTO 3 In this experiment, the Unimate 2000B manipulator holds a commercial pop-rivet gun on a special compliant wrist mounting made of leaf springs. Two strain gauges on the springs enable the computer-controlled manipulator to find the tiny holes in the top of the box by feel alone, without using a camera. The manipulator inserts a rivet (carried on the end of the gun) into each hole and then "pops" (expands) it by turning on a compressed air supply.**

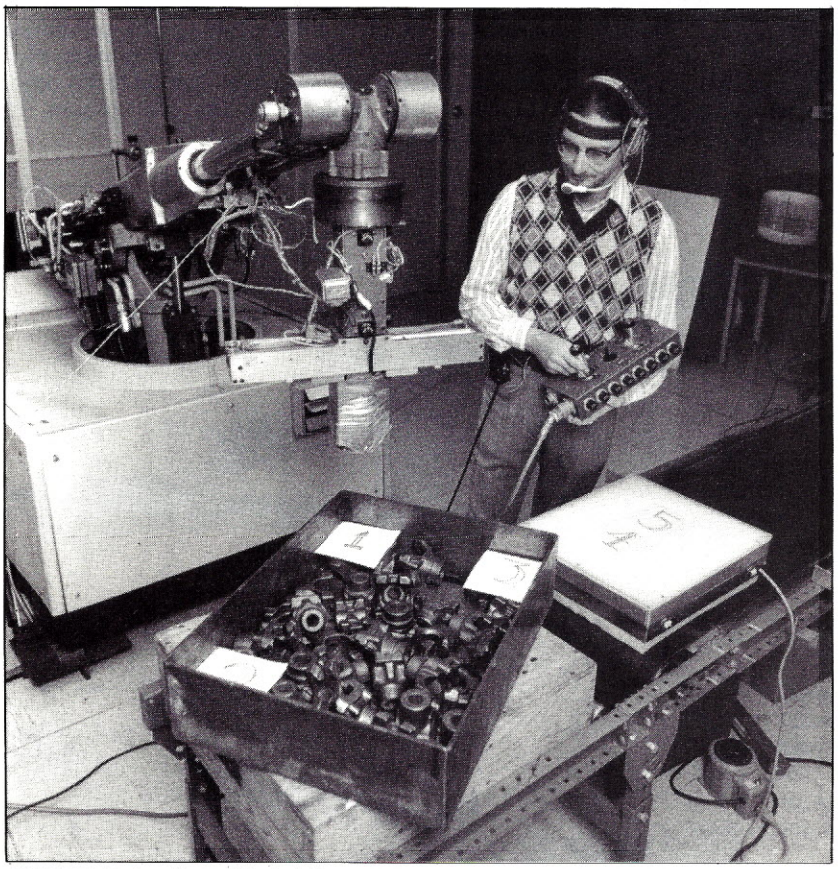


**PHOTO 4 The SRI experimenter is "showing" the Unimate 2000B manipulator the locations of three corners of a tote box from which it is to unpack iron castings with the electromagnet that it is holding. The man can move the arm either by speaking to it through the head-mounted microphone or by moving joysticks on the portable control box that he is carrying.**

Photos provided courtesy of Stanford Research Institute

Robert Shier, general superintendent of Chrysler's Belvidere, Illinois assembly plant feels that integrating robots into plant operations was a positive move. "The robots provide numerous benefits compared with similar manual operations," he said. "Repeatability is one of their prime benefits; they repeat within .070-inch and make the exact number of welds on each body. Additionally, the robots operate consistently at a faster rate than manual operations, and don't require safety or environmental considerations."

Although the robot has proved its worth on the assembly line thus far, like its human counterpart, it is not perfect. No robot manufacturer can guarantee absolute accuracy or repeatability, no matter how sophisticated the unit. The best any of the major producers can offer is a repeatability of ±0.050 inch. Though this is not too far from the ability of the human arm, most buyers would like a guarantee of absolute accuracy when they're considering spending thousands of dollars for a product.

Cost is another important limitation. In order to justify the monetary output for assembly line robots, production level has to be consistently high, while time and cost savings must be clearly shown. The use of robots in industry is a comparatively new trend, and many heads of industries are yet to be convinced that these mechanical workers are worth the going price.

Until recently, robots have been used mainly in simple, repetitive, pick-and-place jobs. The models primarily used by industry are capable of handling a variety of low-level chores, where the work object either moves to the robot or the work surrounds it. In some cases, the cost of utilizing these capabilities is justified; in many others, it is not.

While the most common robots in today's industrial environment are the simpler models, research into the field is continuing and most sophisticated "thinking" robots are being introduced and tested in a number of industrial settings.

According to William Park, Senior Roboticist at Stanford Research Institute's Artificial Intelligence Center, robots with microcomputer "brains" are now learning their jobs through written instructions and are capable of sensing their surroundings.

Researchers at SRI have developed a completely automatic sequential recognition system that can be applied to parts recognition for materials handling and to a number of well-specified inspection problems. According to researchers Gerals J. Agin and Richard O. Duda, the system developed at SRI is ready for cost-effective factory application.

SRI's initial program development for the integration of vision with manipulation took place on a large time-shared PDP-10 computer. Most of the low-level software was recoded for use in a PDP-11 minicomputer, with 28K of 16-bit core memory. According to Agin, the switch was made to demonstrate that the techniques were cost effective and to achieve the real-time response of a dedicated system.

In the initial work, television cameras were interfaced to core memory in the PDP-10 through a high-speed analog-to-digital converter, which quantitizes the image to a raster of 120x120 points with 32 levels of brightness. On the PDP-11 computer, a linear diode array was mounted above a moving belt. The array reads 128 one-bit samples across the belt each time the belt moves 0.05 inch.

The computer software for vision developed by SRI researchers processes binary images quickly and efficiently. In some applications the computer is used to automatically adjust the binary threshold, making better use of the linear range of the camera and providing additional flexibility not available with fixed thresholds.

The heart of the vision system is a one-pass algorithm which breaks an image up into its connected components. The algorithm finds each simply connected region in the image, accumulating perimeter lists, first and second moments of area and other descriptors as it proceeds.

The average time for processing an image runs about 200 milliseconds, thus a camera mounted on the arm of a robot can "see" objects on a conveyor belt, and while the arm is doing its job — such as bolting — the camera surveys the work area, noting anything out of the ordinary.

Agin emphasized the importance of making the capabilities of the sighted robot easily accessible to the people who will maintain and operate it; people who may not have a deep knowledge of computer programming. In simple materials handling applications, examples of parts to be recognized can be shown to the vision system to form a training set.

For more complicated inspection problems, Agin said conventional computer programming methods can provide a broad capability for making specific checks of particular features and for establishing tolerance limits.

The SRI research team believes it is possible to put together a complete inspection system at a market price of under $10,000. They base the figure on a price of around $1,000 for a solid-state camera available in 128x128 resolution; a microcomputer with 16K of random access memory priced at $1,000; and the varying costs for developing a software program.

A low-cost inspection system of this kind could start a revolutionary trend in industrial production. As Park has pointed out, utilization of a simple pick-and-place robot must involve mass production in order for the robot to be considered cost effective.

"In order to do anything useful with such a limited machine, the manufacturer has to make sure that all its tools and workpieces are held in precise positions for the robot to pick up or work on," he said. "Building the jigs and fixtures needed to hold objects in position is expensive, so to pay off the cost of this 'hard tooling' the manufacturer may have to make a batch of tens or hundreds of thousands of the products."

According to Park, sensory control of a robot allows it to make smaller batches of products economically by reducing the tooling costs. "Think of it this way," he said. "The ability to see and/or feel allows a robot to locate objects that it must handle or work on. Without these abilities, the robot is at the same disadvantage as a one-armed human worker who is also blind, deaf, dumb and numb."

So, we are now looking at the very real possibility of introducing industry to a mechanical worker which is not only efficient, but could be classified as relatively cheap labor as well. General Motors will be one of the first large corporations to take a chance on the new sighted robot, having recently announced plans to add one to its assembly line within the next year.

While the rest of American industry watches and waits to see the outcome of General Motors' experiment, research into vision inspection continues. SRI is working on a programming system for industrial control of manipulators and vision which will allow on-line reprogramming. General Motors Research Laboratories in Warren, Michigan has experimented with visually guided mounting of automobile wheels and the inpsection of transistor chips for automotive ignitions. Current research at GM involves a materials handling system to identify objects in situations where binary imaging is not possible.

A number of other laboratories have been conducting research in extending the capabilities of computer vision toward industrial automation. The RANN program has funded a significant portion of the research at universities and independent research laboratories in this country.

Abroad, the Japanese, English and West Germans have made considerable headway in the area of vision inspection, although they have not received wide publicity in this country.□



# GA: I Hear You

By Carl Warren, Editor-in-Chief

Imagine yourself being in a room full of people and not being able to communicate. A scene from a nightmare? Not really. Thousands of people, in this and other countries, find themselves in this situation daily. The reason? They are deaf. Some are lucky, they are only deaf to certain tones or frequency ranges. Others, however, are unable to hear even the loudest of sounds.

The saddest part of being deaf is that of being left out. Conversations are carried on without the deaf being able to partake either in what is being said, or to add to it. The hardest part of being deaf is the inability to communicate with the hearing. Very few hearing Americans have availed themselves of the techniques needed to communicate with the deaf, or are even willing to have the patience to try it.

The deaf have difficulties that the hearing cannot even imagine. For example, when a baby cries at night a deaf mother cannot hear the child; or when a crisis arises, cannot communicate with an emergency service for help. Even trivial tasks such as ordering a pizza by phone are an impossibility for a deaf person.

Yet with all the difficulties that this handicap does present, the deaf seem to be stronger-willed than most. As a result, they are able to overcome the problems that the loss of hearing causes.

A graphic example of this ability to overcome the hearing handicap is Nanette Fabray, who for most of her adult life wore hearing aids yet was able to maintain a successful acting career. Not all who have a hearing impairment are able to come into the public eye, but most are able to cope.

## THE EAR — A DELICATE MACHINE

Infrequently do we think of our ears, although every day we hear sounds that make it possible for us to function in our normal activities. For some, such as air traffic controllers, the ear is a tool of the trade. Sound technicians or piano tuners develop their abilities to hear to perform their intricate work. Most of us, however, use our ears to perform one basic function — communicate.

The ear is one of the most unique and delicate devices the human body has. The ear, along with the eyes, is the interface to the outside world. When one of these paths or interfaces is interrupted, so is the communication ability of the human body to the outside world.

As shown in Figure 1, the ear is made up of several parts. Each serves a special purpose in the response called "hearing." When any one of the parts of the ear become disrupted in some manner, hearing is impaired.

To liken the ear to a computer system, imagine the outer ear or external ear as a keyboard. Here the information is collected and channeled through a cable — external auditory canal — to the eardrum, or serial/parallel interface. At this point, the signal is converted into information readily usable by the computer — or ear — through a network of electronics — in this case the malleus, incus, stapes.

The Eustachian tube connects the middle ear with the upper throat area and is a pressure equalizing valve. This pressure valve makes it possible for you or me to operate in different atmospheric pressure zones. This can be likened to a baud rate selector in a computer which adjusts to the environment — speed — of the data being sent.

Within the ear, once the sound is received and converted to usable information for the body, it must be stored in the main mass storage device — the brain. The nerves connecting the brain to the inner ear act much the same as the ribbon cable connecting the computer to the disk drive.

As mentioned before, a disruption of any one of the components in the hearing chain, or computer system, results in some loss of communication; and, if severe enough, a complete loss of hearing or communication ability. All of us at one time or another have experienced the feeling of our ears being full, and not being able to hear low tones. This is due to a major change in middle ear pressure, such as happens

in an airplane. Usually yawning will cause an equalization of the pressure and restore normal hearing.

Because the loss of hearing — in the acute sense of the term — affects so many, it is important that the understanding of deafness and its social impact not be trifled with. Although the study of the subject and its complete understanding is important, it is not the purpose of this article to try to describe all the types of deafness and their treatments. It is, however, my purpose to stress the importance of communication between the hearing and non-hearing.

## PREPARING TO BE HEARD

Because communication is so important in our daily lives, everyone wants a voice, or at least in some way to be recognized. The deaf are no different.

The most difficult form of communication for the deaf is by telephone; you need to be heard and hear to effectively communicate. The deaf have partially solved this dilemma by using teletype machines with modems to set up deaf to deaf communication. In some cases, organizations have been established to provide a clearing house for messages sent by machine to individuals or companies that do not have the equipment to communicate with the deaf.

The teletype system, although reliable, does cause some difficulty in that it is heavy and fairly expensive — 800 to 1,000 dollars. The problem of maintenance is also of prime importance.

To solve this problem, C-Phone Inc., of St. Louis, Missouri, was formed by a group of deaf teletypewriter servicemen in 1975. Their goal was to develop a low cost, maintenance-free telecommunications device for the deaf. Part of the impetus for this was the difficulty for the deaf to find either free or low cost equipment.

Along with developing the terminal, these men developed the Greater St. Louis deaf telephone network, and wrote the "Teletypewriters Made Easy" service manual.

The terminal designed for the deaf was dubbed the C-Phone and sells for $550 including shipping, which is a vast improvement over similar devices. The C-Phone offers more than just low price. The unit can communicate with devices that handle 45 baud. With later units, the ability to communicate at up to 300 baud will be possible.

Because the designers of C-Phone are so attuned to the needs of the deaf, being deaf themselves, the unit has gone through several iterations to come to the present model, and the upgrades will be continued. One of these will be the auto sensing of speed so the C-Phone can lock onto a particular device.

The C-Phone, shown in Photo 1, is similar in design to the Micro-Term ACT V and Mime terminals. The reason for this is that the terminal is built by the same people who created the Micro-Term line, although they are a separate company.

Because of the support of Micro-Term, the C-Phone sports the same reliable design and high technology found in all the Micro-Term products. The C-Phone, being primarily a functional telecommunications device, has certain features that enhance this function, as shown in Table 1.

One of the differences of the C-Phone, besides the built-in modem, is the addition of the BLANK key used to send the letters GA. This two-letter code means Go Ahead, and signals the receiver that you have finished what you are saying and that he or she can now respond.

The one function of the C-Phone that sets it off from other telecommunications devices for the deaf is the ability to preform a message before making a call. This makes it possible to plan the message and spend as little time on the phone as necessary, thus reducing phone bills.

Another unique function of the C-Phone is the sound sensing device that can be placed on the phone. This, tied in with a lamp that can be plugged into the back of C-Phone, makes it possible for a deaf person to be signaled when the phone rings. Just one of the small things that could only be thought of by a designer who also has a hearing impairment.

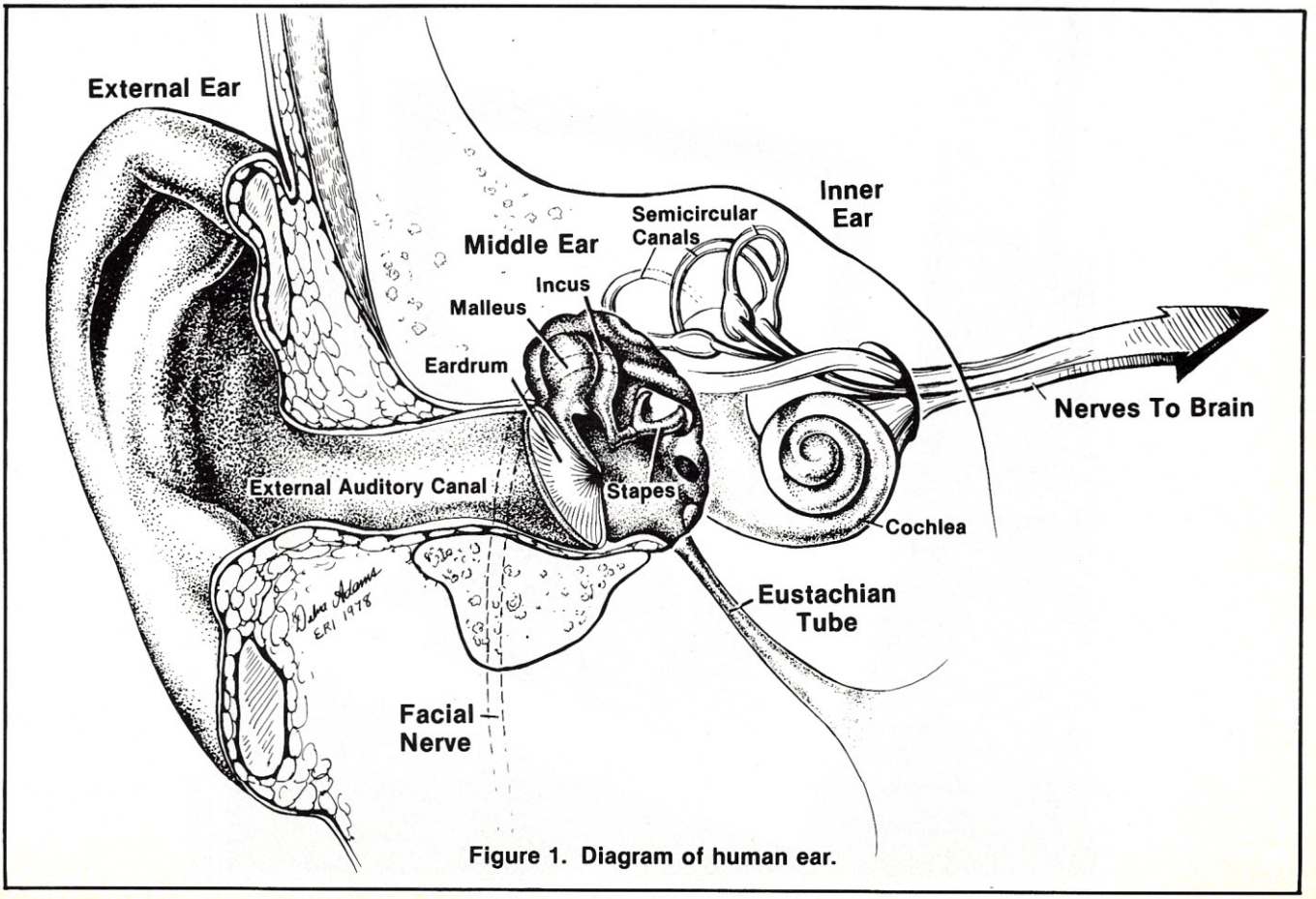



**Figure 1. Diagram of human ear.**

## THE POSSIBILITIES

With the advent of terminals such as C-Phone, it is conceivable that deaf people can now be considered for jobs that were until now only available to the hearing. One such possibility is that of an airline reservation agent. Using a C-Phone, the agent can be trained to handle those calls from the deaf. The possibility also exists of using the deaf in emergency communication dispatch offices.

One question that can come to mind is: "Why not use the hearing to man the terminal?" The primary reason is that those who are deaf have a better understanding of others who are deaf, and have the patience to communicate more effectively. Also the deaf are not subject to distraction and tend to be more meticulous than a hearing person performing the same job.

Although the C-Phone is not the final answer in helping the deaf communicate, it is a major step in the right direction.

## FURTHER INFORMATION

For those who have a hearing impairment, or know of someone who does, the following list is provided to help in obtaining information.

C-Phone Inc.
1314 Hanley Industrial Court
St. Louis, MO 63144

C-Phone is able to provide information on the C-Phone terminal, and the Greater St. Louis Deaf telephone network.

Ear Research Institute
256 South Lake Street
Los Angeles, CA 90057

Greater Los Angeles Council on Deafness, Inc. (GLAD)
621 South Virgil Avenue
Los Angeles, CA 90005

Better Hearing Institute
1430 K Street NW, Suite 200
Washington, DC 20005

Otologic Medical Group Inc.
2122 West Third Street
Los Angeles, CA 90057

The above organizations can provide pamphlets that describe deafness, and what needs to be done. Also, in some cases, they provide information on clinics that specialize in hearing problems.

*The Deaf American*
National Magazine for all the Deaf
5125 Radnor Road
Indianapolis, IN 46226

This magazine is devoted to the deaf. It provides information on books, services, and medical plans for the deaf. They also have a special section devoted to deaf societies.

National Association of the Deaf
814 Thayer Avenue
Silver Springs, MD 20910




PHOTOGRAPH BY SHELLEY WRIGHT

**Table 1. Message Preparation and Sending Mode**

| ACTION DESIRED | HOW? | COMMENTS |
|---|---|---|
| Prepare message | Depress and hold SHIFT key down and hit CTRL key on right side of keyboard. | This action blanks the screen and returns the cursor to the upper left corner. You can prepare your message. |
| Type out message | Type message just like on a typewriter. | The message you type can fill the first 23 lines. The 24th line is reserved for conversation. |
| Correct message | Position cursor over character to be corrected by use of LINEFEED and BACKSPACE keys. | To change each individual character, the cursor must be placed over the character to be changed and the correct character is retyped in place. Depressing or holding down either the BACKSPACE or LINEFEED key cause cursor to move rapidly across the screen until key is released. |
| Freeze message | Hit CTRL key once. | First 23 lines are frozen and cannot be altered. You will have two cursors, one at the top and one at the bottom. The last line (24th line) is reserved for normal conversation over the phone. All conversation will occur on that line only. This is especially helpful in establishing proper contact with the intended party before transmitting message. |
| Send message (Can be repeated as many times as you wish) | Hit CTRL key once again. | Message will be sent to any telecommunication device for the deaf at standard 60 wpm. At conclusion of message, the unit will revert to the 24th line, you can converse on that one line only. It is a good habit to hit the CLEAR key after message is sent to revert to the normal conversational mode, i.e., full screen available for conversation. However, if before hitting the CLEAR key you wish to send the same message you typed to another party with some corrections, depress the SHIFT key and hit the CTRL key once. You can now correct and prepare this message and transmit this by following the procedures as outlined above. |
| (If someone calls while you are preparing a message, DO NOT panic and hit the CLEAR key. Instead hit the CTRL key once. This will put you on the (24th) line and you can converse on that one line only. After hanging up, you can return to your unfinished message by depressing the SHIFT key and hitting the CTRL key. With the LINEFEED and BACKSPACE keys you can go back to where you left off and complete your message.) | | |

This is the Association behind the Deaf American, and any requests for subscriptions or information regarding the deaf should be sent directly to this association address.

U.S. Department of Health, Education and Welfare
Office of the Secretary
Office for Civil Rights
Washington, DC 20201

This office can supply information on rights of handicapped persons under federal law. Ask for Section 504 of the Rehabilitation Act of 1973.

The following books can be obtained from most public libraries. If unavailable, write to one of the above agencies for information regarding availability.

*Handbook of Information for the Hard of Hearing*
by Charles G. Bluett (California State Department of Education)

*Conversational Efficiency*
by Martha Bruhn

*The Story of Lipreading, Its Genesis and Development*
by Fred DeLand and Harriet Montague

*Listen . . . Please*
by Ada Ruth Dogger

*Opportunity and the Deaf Child*
by Ewing and Ewing

*Speech and the Deaf Child*
by Ewing and Ewing

*Hearing and Deafness, A Guide for Laymen*
by Hallowell Davis, M.D.

*Hearing is Believing*
by Marie Hayes Heiner

*The Teaching of Speech*
by G. Sibley Haycock

*Introduction to Lipreading*
by the Better Reading Foundation, New York

*Graded Material for Lipreading*
by Cora Elsie Kinzie

*Language for the Deaf Child*
by Grace Lassman

*Auditory Disorders in Children*
by Helmer Myklebust

*Teach Yourself Lipreading*
by Olive Wyatt

*Practical Suggestions for Persons with a Hearing Impairment*
by the Ear Research Institute, Los Angeles, CA
(This is one of several publications the Ear Research Institute makes available for the better understanding of hearing impairments.)

## ACKNOWLEDGEMENTS

Photo Division, CBS Television Network Press Information, 51 West 52 Street, New York, New York 10019, for the use of the title page photo of Jeffrey Bravin, portraying Jonah Corelli, a 7-year-old deaf child. This is from the made-for-television motion picture "And Your Name is Jonah," presented January 28 on CBS.

Also the Ear Research Institute of Los Angeles for providing the artwork for Figure 1, and the information on hearing impairment and the agencies serving the deaf community.

Finally to Mike Marks and the men and women behind C-Phone Inc., who spent the time to present the idea of the terminal plus provide the necessary information required to create this article.□

**Table 1.**

**PRO-TYPE Command Summary**

| | |
|---|---|
| A | Switch to **Alternate** text area |
| B | Print text storage area (**Buffer**) values and allow changes |
| #C | Move pointer # **Characters** |
| #D | **Delete** # characters |
| E | Enter **Edit** mode |
| +#F | **Find** string\ and set pointer after it |
| G | **Get** text from Q buffer and insert it at pointer |
| +#H | Enter the ASCII character # into the text at pointer |
| I | **Insert** text until a backslash (\) is typed |
| +#J | **Jump** pointer to the start of text plus # characters |
| #K | **Kill** (delete) # lines |
| #L | Move pointer # **Lines** |
| +#M | Execute **Macro** # times; if # is 0, exit to the **Monitor** |
| O | Define **options** for tab, line, page and skip lengths |
| +#P | **Punch** (write) the text on drive # as the file named after the P |
| #Q | Fill the Q buffer with # lines; if # is 0, empty the Q buffer |
| #R | **Replace** # characters with a new string\ |
| +#S | **Search** and **Switch** string 1\ with string 2\; do this # times |
| #T | **Type** # lines in the same form as entered |
| #U | Type lines as for T, but allowing ^Y and ^Z commands |
| #V | **Verify** # complete line with control characters preceded by ^ |
| +#W | Print # lines in right-justified format |
| +#X | *Print* # lines of limited length |
| +#Y | **Yank** (read) inthe text file named after the Y on drive # |
| +#Z | List the directory of drive # |

NOTE: # means any number and +# means a positive number)

**Control Characters**

| | |
|---|---|
| ^A | Switch to **Alternate** text area |
| ^B | Reset pointer to **Beginning** of text |
| ^C | Separator for numbers and underlines |
| ^D## | Set the left margin to column ## |
| ^^E## | Set the right margin to column ## |
| ^F | (Edit) **Forward** one character |
| ^G | Ring the bell and pause until ^G is typed |
| ^H | (Input) backspace and delete one character |
| ^I## | Tab to column ##; if ## is omitted, use the default column |
| ^J | (Line Feed) |
| ^L | Advance to the top of the next page (form feed) |
| ^M | (Carriage Return) |
| ^O | Restore the **Old** printing mode in effect before the last ^Q |
| ^P# | New **Paragraph**; print # extra carriage returns |
| ^Q | **Quit** W or X printing mode and continue in U mode |
| ^R | (Edit) **Reverse** one character |
| ^S# | Set the line spacing to # |
| ^T | (Edit) **Terminate** editing |
| ^U | **Underline** the previous word |
| ^W | (Edit) Space forward one **Word** |
| ^X | (Input) Delete the entire line; (edit) delete one character |
| ^Y | **Yank** (read) in the file named after the ^Y |
| ^Z | End of text; form feed and stop |

NOTE: # and ## are one- and two-digit positive numbers, respectively

# PRO-TYPE

# A Low-Cost High-Quality Wordprocessor

By Carl Warren, Editor-in-Chief

You have probably heard the sayings that there is nothing surer than death and taxes, and paperwork will bury the world. Very true statements, no matter what your viewpoint.

I doubt if anyone will be able to find a unique solution to the problems of death and taxes, but several companies have made great efforts to solve the paperwork problem. The companies that are involved are those that provide software for the rapidly growing business microcomputer market. One such company, Interactive Microware Inc. of State College, Pennsylvania, has — as mentioned in the December 1978 issue of INTERFACE AGE — developed a low-cost quality wordprocessing system for the low end micro user.

The wordprocessing system developed by Interactive is called PRO-TYPE. Written by Dr. Paul K. Warme, the system is designed to be used on either a MECA Alpha I tape system in conjunction with their tape operating system, or with a North Star disk system using either North Star DOS or DOS+ — a disk operating system also developed by Dr. Warme.

## SYSTEM ENVIRONMENT

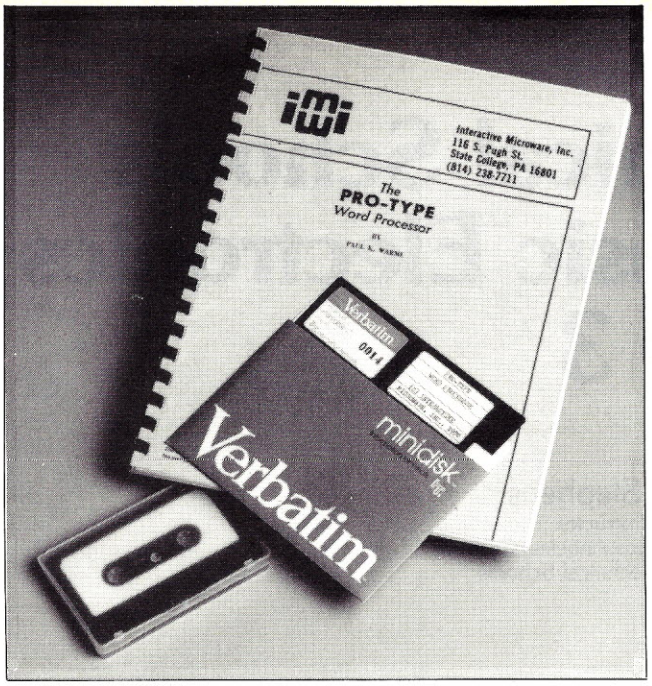
The PRO-TYPE wordprocessing system is designed to be used on terminals that do not have memory mapping capabilities. As originally designed by Dr. Warme, the wordprocessor was developed for use on hardcopy type terminals such as a DECwriter or similar devices. However, due to the flexibility of the I/O structure, the system can be used on a CRT-type terminal with the copy being driven out to a printer.

PRO-TYPE occupies 8K of memory plus the amount of storage required for the text. The text buffer is dependent on the amount of available RAM and the location of the operating system. For example, a 48K system with the MECA TOS located at A000 HEX allows approximately 24000 memory locations for storing text.

Because PRO-TYPE is designed to be interactive with both the MECA and North Star systems, named files can be saved on the media for future processing.

Although PRO-TYPE is designed primarily around the MECA and North Star systems, it is easily adapted to other operating systems. The necessary I/O patching information is contained in the 72-page users manual.

One main feature of PRO-TYPE is the users manual. According to Warme, as much time went into developing the documentation as the system itself. This care in documentation is highlighted by the clear, concise examples explaining each of the many functions of the software system.




## UNIQUE FEATURES OF PRO-TYPE

Basically this wordprocessing system has one feature that makes it unique. This feature is that it is a combined system. The editing and wordprocessing functions are built into the single program. This means that it is not necessary to first prepare the text then process it later with another piece of software.

Other features include the ability to change the right and left margins dynamically while preparing the text. This function, combined with the built-in wordprocessing, makes it possible for the user to quickly check on the format of the document as it is being prepared. Also, switching to an alternate text area is provided and can be considered a standard feature of most text processing systems.

One function that is useful is the underline capability. Using this function, words that need to be highlighted — or emphasized — can be flagged. Words that are to be underlined are so indicated in the edit mode by entering a control U (^U), for underline.

Text is saved on the mass storage device by using the P — punch command. The drive to be used is specified, followed by P and up to 8 characters for the file name. For example, a piece of text might be saved by using:

1PMESSAGE

The file name will be truncated to 5 characters and will look like the example shown in Figure 1. The MECA system saves the file in this manner, and displays the file name, length in bytes, and linear location on tape.

```
                DRIVE 0  TEND=08CA
NAME    BYTES   TLOC       NAME    BYTES   TLOC
PROTP   2174    0546       MESSA   03FD    0858
OK--
```

PHYSICAL LOCATION ON TAPE

LENGTH OF FILE IN BYTES

FILE NAME TRUNCATED TO 5 CHARACTERS

**Figure 1. Meca Directory with Text File**

When the file is again called for by entering:

1YMESSAGE

PRO-TYPE responds by returning the file name, length and location, plus the buffer message (Figure 2). When a file is Yanked into the edit buffer of PRO-TYPE, the previous contents are destroyed and the new information becomes the most current. The process is much like an automatic NEW command when a LOAD function is executed in BASIC.

```
                YANK COMMAND
DRIVE NUMBER        FILE TO BE YANKED
? 3YMESSAGE
MESSA 21CA 25C6BEG 8650 PTR 8650 END 9669 EOM 32000 CHANGES ?
?
                    LOCATION ON TAPE
              LENGTH
FILE NAME
```

THIS PORTION OF MESSAGE DELIVERED FROM MECA

**Figure 2. Example of yanking a file into the text buffer.**

As a result of this auto NEW function of PRO-TYPE, it would appear that utilizing so called *boiler plate* would be impossible. This is definitely not the case. Although not spelled out in the manual, the function of pulling in multiple files does exist. This function is accomplished as follows:

1. Yank in an existing file or build a new file.
2. Enter the B command to find the buffer locations — see Table 1 for command examples.
3. Set the BEG — beginning of the buffer equal to the END — end of file (Figure 3).
4. Yank in the next file and reset BEG to the initial value.

```
? B
BEG 8650 PTR 8650 END 9669 EOM 32000 CHANGES ? 9669

? B
BEG 9669 PTR 8650 END 9669 EOM 32000 CHANGES ?

?
```

**Figure 3. Setting the BEG — beginning of buffer — equal to end of text, prior to yanking in a file. Used for multiple file operations.**

This process can be repeated as often as necessary and, of course, as long as you have room in the text buffer. Using this procedure, special format files can exist and be called as needed to perform some specific function.

The multiple file function works with both the primary and alternate text areas, and may be used to set up an almost totally automatic method of letter writing. Besides enhancing the multiple file function capabilities, the alternate text buffer is useful for moving blocks of text from one location to another in a manuscript.

## GETTING USED TO PRO-TYPE

Any software system, to the uninitiated, appears somewhat imposing. PRO-TYPE is no different. The initial fears appear to be due to the use of control characters to control the functions of the system. As shown in Table 1, almost every letter in the alphabet has been used twice to perform a specific function. This, on the onset, may seem like a tremendous amount of information to absorb to use a wordprocessor. But because PRO-TYPE is both a text editor and wordprocessor, this type of command structure is necessary to achieve maximum efficiency of the program. Even though the system may appear unorthodox in structure, it is easily learned in a few hours, and complete mastery can be accomplished in just a few days.

For those who are looking for a bargain in business software, PRO-TYPE may meet your needs. Selling for $75, PRO-TYPE can be considered a mid-priced system with maxi capabilities.□

# National Technical Schools Mini-Series of Basic Electronics Unit 3

By Walter F. Stephens
Assistant Chief Instructor
National Technical Schools, Los Angeles, California
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In a previous tutorial, reference was made to computer terms, such as bits, bytes and words, being related in some form to binary numbers. The inference here is that the computer utilizes a number system other than the decimal system most people are acquainted with. Digital computers today employ the binary numbering system in one code form or another for operation, as well as the octal and hexadecimal systems for data input and output purposes. This month we shall survey the various numbering systems used in computer operations. The structure of each system, as well as the conversion methods from one system into another shall be presented. Due to space limitation, arithmetic operations will be confined to the binary system only. In addition to numbering systems, logic is also introduced with the discussion on basic logic elements, such as "AND" and "OR", and functions.

## HISTORY

Before we get too involved in our discussion of number systems, it might be useful to briefly investigate some of history's earlier number systems and counting methods. The tally method (still used among some agricultural and ranching applications) is an apparent evolution of the "one by one" counting method. In this unitary method (Figure 42a), only one mark or symbol is used. However, the tally method (Figure 42b) modifies this, as it consolidates 5 marks into one group, in which the group itself becomes a symbol denoting 5 things.

Figure 42c shows the stick method (early Asian) of counting; each count had its own symbol to indicate the count magnitude. However, only nine symbols are used in this method. The Chinese employed a 10-digit system as well as another system used as the basis for the abacus. A unique number system based on 20 digits and utilized by the Mayan civilization in Central America some 5,000 years ago is shown in Figure 42d. It is interesting to note in both the Mayan and Arabic system the first numeral is zero (0), whereas other number systems did not employ zero as a digit.

Let us keep this point in mind while we take a look at another important similarity. In our decimal system we use the Arabic symbols 0 through 9. Take the decimal number 666.0 for example. The symbol "6" has three different values (magnitudes) and these values depend upon the column in which the symbol "6" appears. This is referred to as positional value (weight) or positional notation. (Note: In certain beliefs, the number 666 is believed to have a satanic relationship. The use of this number as our example is merely for illustrative purposes only.)

The position of the number (digit) was also of importance to the Mayan number system. Instead of positional value by column, this system utilized positional value by row. Figure 43 illustrates the positional concept in both the decimal and Mayan systems. Whereas the decimal system progresses by tens, such as 1, 10, 100, 1000 etc., the Mayan system progresses by 20's, such as 1, 20, 400, 8000, 16,000, etc.

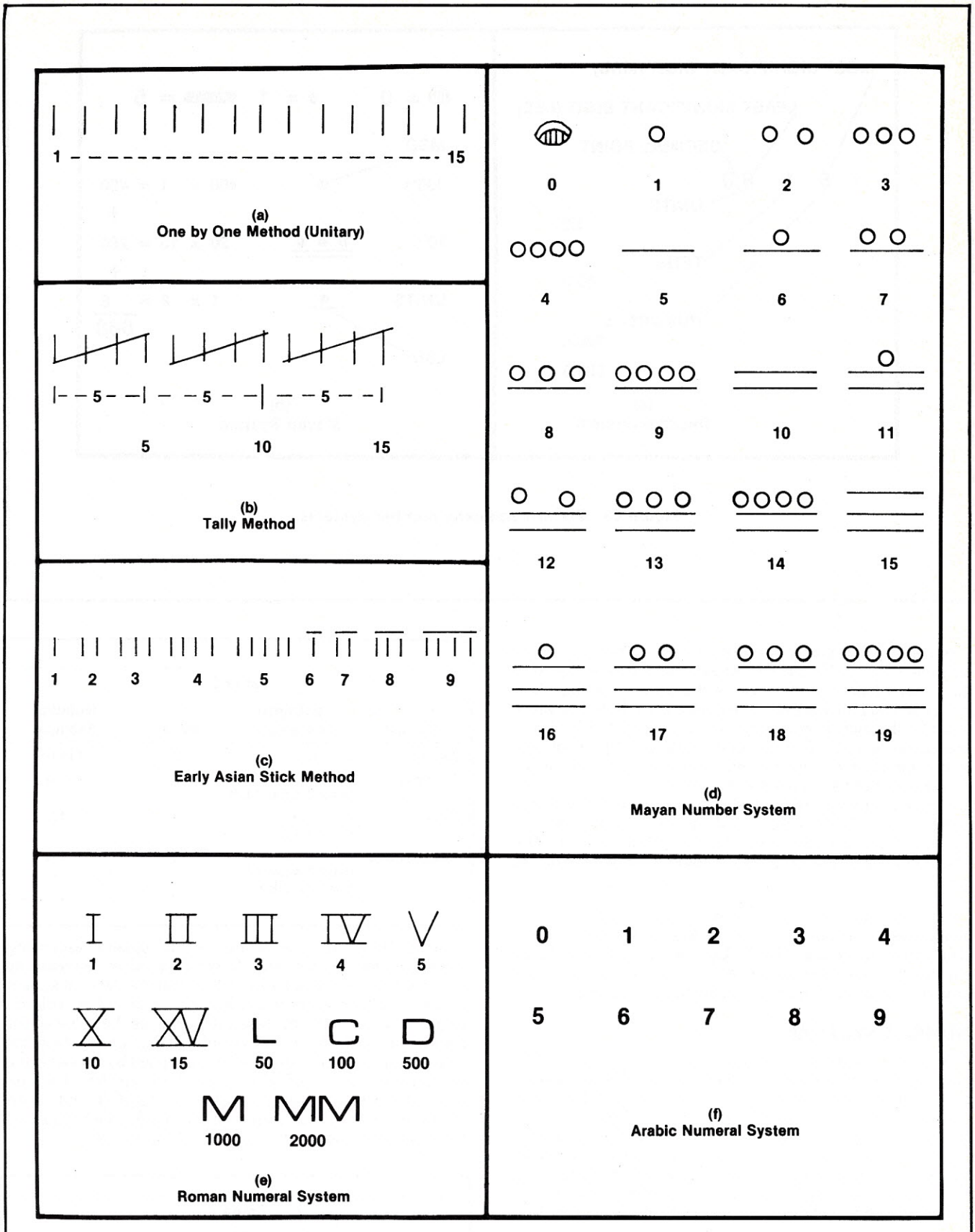

1 15
(a)
One by One Method (Unitary)
5 10 15
(b)
Tally Method
1 2 3 4 5 6 7 8 9
(c)
Early Asian Stick Method
0 1 2 3
4 5 6 7
8 9 10 11
12 13 14 15
16 17 18 19
(d)
Mayan Number System
I II III IV V
1 2 3 4 5
X XV L C D
10 15 50 100 500
M MM
1000 2000
(e)
Roman Numeral System
0 1 2 3 4
5 6 7 8 9
(f)
Arabic Numeral System

Figure 42.

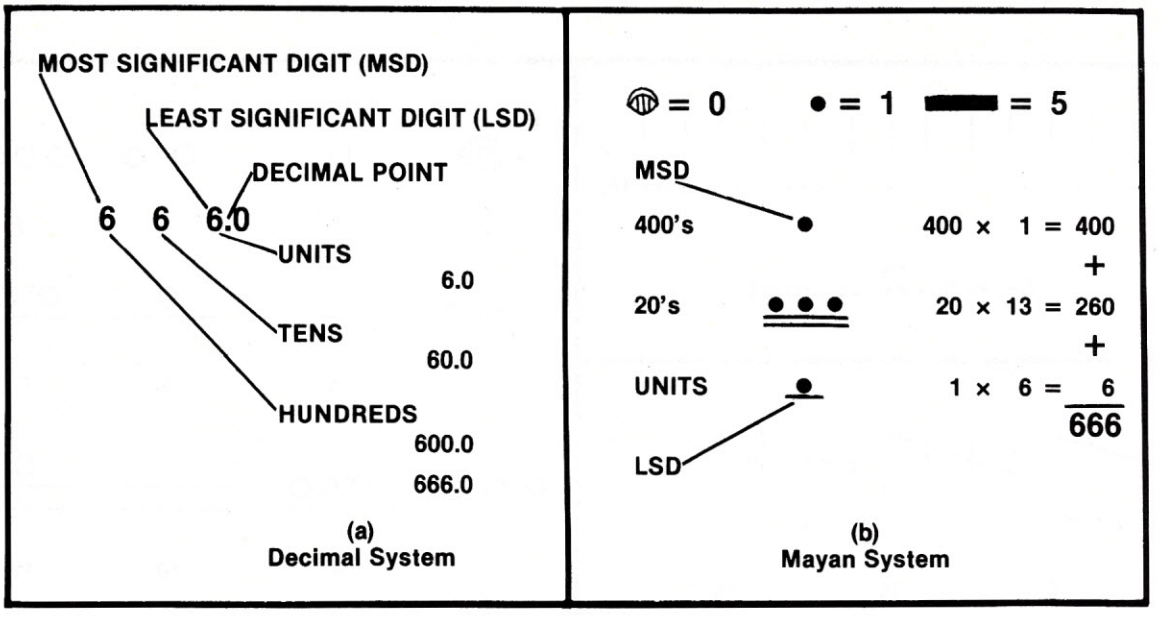



**Figure 43. Modern and early number systems.**

According to Webster, the Romans used letters as numerals until 10 A.D. Figure 42e shows the values assigned to the various letters. In the case of the symbol for four, V is preceeded by I. In this case, one is subtracted from five with a result of 4. Such is also the case of 9, the letter X (10) is preceeded by I (1). The numeral nineteen (19) is indicated by the symbol XIX, here the letter I is subtracted from the letter X to the right and added to the letter X to the left. Where the letter to the right of the first is smaller or equal, we have addition. Such is the case of XV, symbolizing the value of 15. A bar over the letter indicates multiplication by 1,000. The numerical value of 50,000 would be indicated by the symbol L.

Since arithmetic manipulation of these numerals proved to be awkward and clumsy, the use of this system began its decline sometime before 10 A.D. By referring to Figure 42 we may think of a number system as being a set of symbols representing quantity, regardless of the system utilized.

## NUMBER SYSTEMS

Number systems are useful for indicating quantity and sequence, and for performing computations. The complexity of the calculations which can be performed, and the mathematical techniques which are likely to be developed, are determined in some measure by the number system employed.

Since the decimal system is rather an inconvenient one for the electronic digital computer, we shall discuss the systems that are more suited to digital computer operation. However, we will begin with a brief overview of the familiar decimal system.

### Decimal System

A review of this system will help us initiate some ground rules for setting up number systems with any base (radix). The base or radix tells us how many digits or symbols are used in the system (Table 2).

**Table 2.**

| System | No. Digits/ Characters | Base | Notation Example |
|---|---|---|---|
| Binary | 2 0-1 | 2 | $1111_2$ |
| Decimal | 10 0-1-2-3-4-5-6-7-8-9 | 10 | $15_{10}$ |
| Octal | 8 0-1-2-3-4-5-6-7 | 8 | $17_8$ |
| Hexadecimal | 16 0-1-2-3-4-5-6-7-8 9-A-B-C-D-E-F | 16 | $F_{16}$ |

Since 10 is the base of the decimal system, ascending values increase by ten, and descending values decrease by increments of ten. It is further noted that the decimal system is based on the powers of ten. Multiplying any of the column values in Table 3 by the base (10) gives us the value of the column just to the left of it. Example, $10^3$ column, which has a positional value of 1,000, when multiplied by 10 yields the positional value of 10,000 for the column just left of it. Column $10^4$ has a positional value of 10,000 and when multiplied by 10 yields a value of 100,000, which would be the positional value of the column just to the left.

**Table 3.**

| Decimal Numbers | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10,000 | 1000 | 100 | 10 | 1 | .1 | .01 | .001 | .0001 | .00001 |
| $10^4$ | $10^3$ | $10^2$ | $10^1$ | $10^0$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ | $10^{-5}$ |
| Power of Tens | | | | | | | | | |

The first column counts in units while the second column counts by tens. The count in the second column is equal to the base of the system. Another common characteristic of the number systems used in computer operation is the count sequence. Notice in Table 4 when the count has reached nine, (highest valued digit in decimal system) and one more count is added to it, our count for that column goes back to zero and a count is fed (carried) into the next column. In our example we added a one to a nine (9+1=10). This happens in any system where the count has reached the highest valued digit (of that system). In the binary system the highest value digit used is one (1), in the octal system the highest value is seven (7), and, in the hexadecimal the alpha character "F".

**Table 4. Decimal Count Sequence Utilizing Ten Digits**

| | | | |
|---|---|---|---|
| 100 | 90. . . . .20 | 10 | 0 |
| 101 | 91. . . . .21 | 11 | 1 |
| 102 | 92. . . . .22 | 12 | 2 |
| 103 | 93. . . . .23 | 13 | 3 |
| 104 | 94. . . . .24 | 14 | 4 |
| 105 | 95. . . . .25 | 15 | 5 |
| 106 | 96. . . . .26 | 16 | 6 |
| 107 | 97. . . . .27 | 17 | 7 |
| 108 | 98. . . . .28 | 18 | 8 |
| 109 | 99. . . . .29 | 19 | 9 |

## Powers of Numbers

What does $10^3$ actually mean? The notation states that 10 (base) is to be taken as a factor three times. $10^3 = 10\times10\times10 = 1000_{10}$, here 10 is the base, and the little number (the 3) above and to the right is the exponent. (Also referred to as the power. It tells how many times the base is to be multiplied by itself.) Two other important points are that, $10^0 = 1$, and $10^1 = 10$. These principles also apply to other number systems that we shall be discussing. In the binary system, it is powers of 2. In the octal system it's powers of 8, and in the hexadecimal system, powers of 16.

## Arithmetic Operations

Terminology is essential to the understanding of the rules (axioms) that are associated with the fundamental arithmetic functions. In the interest of simplification, this is shown in Figure 44.

1. **Multiplication** — Multiplicand × Multiplier = Product

   Multiplicand
   × Multiplier
   Product

2. **Addition** — Augend + Addend = Sum

   Augend
   + Addend
   Sum

3. **Division** — Dividend ÷ Divisor = Quotient

   $\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient}$

4. **Subtraction** — Minuend − Subtrahend = Difference

   Minuend
   − Subtrahend
   Difference

**Figure 44.**

## Binary Systems

The binary number systems, which are base 2 (radix 2) systems, use only two symbols. The digits "0" and "1" are generally employed for binary notation. Each "0" and "1" is known as a *bit*. Therefore, 1001 (decimal 9) is classified as a 4-bit binary number. The binary system is used extensively in electronic digital computers, as the binary bits "0" and "1" can easily be represented by a control device such as the transistor, which is either conducting or cut off.

In electrical and electronic systems, we have a great number of devices that can be operated in either of two stable states. A few examples are given in Table 5.

**Table 5.**

| The device | The stable states of operation |
|---|---|
| switch | on, off |
| transistor, bipolar or FET | saturated, cutoff |
| lamp | on, off |
| voltage (example) | +5V, 0V |
| current (example) | 15 milliamps, 0 milliamps |
| resistance | high, low |
| capacitance | charged, discharged |
| iron | magnetized, non-magnetized |
| relay | energized, de-energized |

Table 5 is only a partial list. *Since there are so many devices with two stable states of operation, it is logical to use a counting system with a radix of 2 for electrical and electronic counting.*

There are fewer devices with 10 stable states of operation, so electrical and electronic counting is seldom done in the decimal system. Since the binary system is used, it is important to become familiar with binary numbers. Table 6 compares the decimal and binary counts up to and including decimal number 15. Study the binary count until you can see the pattern involved. There are certain similarities between binary and decimal count. Note that the right-hand column starts at zero in each case. When all ten digits have been used in the decimal count, a new column is started. This point is illustrated with an arrow.

In the binary count there are only two digits, so a new column is started in after only two digits. This point is also illustrated with an arrow in Table 6.

**Table 6.**

| Digital Count (Count by 10's) | Binary Count (Count by 2's) |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | → 10 |
| 3 | 11 |
| 4 | 100 |
| 5 | 101 |
| 6 | 110 |
| 7 | 111 |
| 8 | 1000 |
| 9 | 1001 |
| 10 ← | 1010 |
| 11 | 1011 |
| 12 | 1100 |
| 13 | 1101 |
| 14 | 1110 |
| 15 | 1111 |

Although it may be true that the decimal system offers the advantage of familiarity for those who are accustomed to its

use, electronic computers are generally designed around bistable or 2-state devices.

This means that the problems to be presented to the computer are first conceived in the familiar decimal notation, put into a programming language, then readily converted into a binary notation suitable for the computer. The computer number codes in use today are modifications of the straight binary code.

## Powers of Two

Since the base of the binary system is two, we shall then show the positional value as related to a power of 2:

| $2^8$ | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 1 | 0 | 1 | 1 | 0 |

**Table 7.**

| | |
|---|---|
| $1 \times 2^5 = 32$ | $2^0 = 1$ |
| $1 \times 2^4 = 16$ | $2^1 = 2$ |
| $0 \times 2^3 = 0$ | $2^2 = 4$ |
| $1 \times 2^2 = 4$ | $2^3 = 8$ |
| $1 \times 2^1 = 2$ | $2^4 = 16$ |
| $0 \times 2^0 = 0$ | $2^5 = 32$ |
| 110110 $= 54$ | $2^6 = 64$ |
| | $2^7 = 128$ |
| (A) | $2^8 = 256$ |
| | $2^9 = 512$ |
| | $2^{10} = 1024$ |
| | $2^{11} = 2048$ |
| | $2^{12} = 4096$ |
| | $2^{13} = 8192$ |
| | $2^{14} = 16384$ |
| | $2^{15} = 32768$ |
| | $2^{16} = 65536$ |
| | $2^{17} = 131072$ |
| | (B) |

As we can see from Table 7, there is no major difference in concepts between the binary and decimal systems, except for the base (number of working digits). You may realize by looking at Table 7a that a conversion from one system to another has taken place. Binary 110110 has been converted to decimal 54.

Our powers of two may also be expanded to cover binary fractions. In this system the base is two. Therefore, proceeding to the right from the binary point to each column, we decrease in value by one half the value of the preceeding column.

**Table 8.**

| Binary Point | $2^{-1}$ | $2^{-2}$ | $2^{-3}$ | Power of two |
|---|---|---|---|---|
| | ½ | ¼ | ⅛ | Positional Value |
| | 1 | 1 | 0 | .5 + .25 + 0 = .750 |

The computer circuits in most cases work with binary numbers. However, as we can see from our example 110110, that when we get into large number representation it's quite cumbersome to use this notation for programming information into the computer. We shall now take a look at another number system that is also utilized in computer work.

## Octal System

In this system the base is eight, so we are working with powers of eight. The positional value concepts also hold true for this system. Another point to consider here is that the number 8 is related to the number 2, since 8 is 2 raised to the third power ($2^3$).

**Table 9.**

| Decimal | Octal | Binary | Decimal | Octal | Binary |
|---|---|---|---|---|---|
| 0 | 0 | 000 | 8 | 10 | 001 000 |
| 1 | 1 | 001 | 9 | 11 | 001 001 |
| 2 | 2 | 010 | 10 | 12 | 001 010 |
| 3 | 3 | 011 | 11 | 13 | 001 011 |
| 4 | 4 | 100 | 12 | 14 | 001 100 |
| 5 | 5 | 101 | 13 | 15 | 001 101 |
| 6 | 6 | 110 | 14 | 16 | 001 110 |
| 7 | 7 | 111 | 15 | 17 | 001 111 |
| | | | 16 | 20 | 010 000 |

Notice that in Table 9 the highest value digit in the octal system is seven, and on the next count the column goes back to zero and a one is carried over into the next column. As we take a second look, we see that one octal digit represents three binary digits. Binary 111 in octal notation is octal 7, octal 10 is represented in binary notation as 001000. This grouping of three binary digits is very useful when converting binary into octal.

## Powers of Eight

**Table 10.**

| Power | $8^3$ | $8^2$ | $8^1$ | $8^0$ | $8^{-1}$ | $8^{-2}$ | $8^{-3}$ |
|---|---|---|---|---|---|---|---|
| Value | 512 | 64 | 8 | 1 | 0.125 | 0.0156 | 0.00195 |

The octal system handles fractions in the same manner as the previous two systems, except with powers of eight we decrease by eights as we proceed column by column to the right of the octal point.

## Hexadecimal System

Here we will be discussing a system based on the powers of sixteen which is also related directly to the binary system, since sixteen is 2 raised to the fourth power.

**Table 11.**

| Decimal | Binary | Octal | Hexadecimal |
|---|---|---|---|
| 1 | 1 | 1 | 1 |
| 2 | 10 | 2 | 2 |
| 3 | 11 | 3 | 3 |
| 4 | 100 | 4 | 4 |
| 5 | 101 | 5 | 5 |
| 6 | 110 | 6 | 6 |
| 7 | 111 | 7 | 7 |
| 8 | 1000 | 10 | 8 |
| 9 | 1001 | 11 | 9 |
| 10 | 1010 | 12 | A |
| 11 | 1011 | 13 | B |
| 12 | 1100 | 14 | C |
| 13 | 1101 | 15 | D |
| 14 | 1101 | 16 | E |
| 15 | 1111 | 17 | F |
| 16 | 10000 | 20 | 10 |

Referring to Table 11, each digit in the hexadecimal system represents a corresponding binary number. Also the positional values of each column either increases or decreases by sixteen times.

**Table 12.**

| Power | $16^3$ | $16^2$ | $16^1$ | $16^0$ | $16^{-1}$ | $16^{-2}$ | $16^{-3}$ |
|---|---|---|---|---|---|---|---|
| Value | 4096 | 256 | 16 | 1 | .0625 | .00390 | .000244 |

In addition to ten digits, six letters of the alphabet are utilized. These letters are representative of quantity. $A5F_{16}$ in hexadecimal notation represents binary 101001011111. Here we separate the binary word into groups of four, proceeding

from the binary point left. Example:

| 1010 | 0101 | 1111 |
|---|---|---|
| A | 5 | F |

You can imagine what help this would be in handling a 32-bit binary word on paper. With reference to our example, what would be easier to read from an output display, the number 101001011111 or A5F? The latter would require only three display units, whereas the former twelve.

### Conclusion

1. The decimal system is the most familiar to all of us because of its utilization in everyday life.
2. The binary system is utilized in digital computers because of its relationship with two-state electronic devices.
3. The hexadecimal and octal systems provide a more convenient method for getting information into and out of the computer, generally.

## CONVERSION METHODS

### Decimal to Binary (Remainder Method)

The decimal number is divided by the base two, retaining the remainder as a part of the binary number.

Example: $29_{10}$

$\frac{29}{2} = 14$ R — 1 LSD

$\frac{14}{2} = 7$ R — 0

$\frac{7}{2} = 3$ R — 1

$\frac{3}{2} = 1$ R — 1

$\frac{1}{2} = 0$ R — 1 MSD

$29_{10} = 11101_2$

### Decimal to Octal (Remainder Method)

The decimal number here is divided by eight, saving the remainder to construct the octal number.

Example: $58_{10}$

$\frac{58}{8} = 7$ R=2 LSD

$\frac{7}{8} = 0$ R=7 MSD

$58_{10} = 72_8$

### Binary to Decimal (Positional Value Method)

Example: $10010_2$

$10010. = 1\ (2^4) + 0\ (2^3) + 0\ (2^2) + 1\ (2^1) + 0\ (2^0)$

$= 16 + 0 + 0 + 2 + 0$

$= 18_{10}$

### Binary to Octal

The conversion of binary to octal is quite simple.

Example: $010101110_2$

a. Starting from the Binary point proceed to the left, dividing the binary number into groups of three 010 101 110.

b. 010 101 110
   2 5 6

c. $256_8$ is the equivalent octal number.

### Binary to Hexadecimal

Here we proceed the same as the octal conversion but divide our number up into groups of four instead of three.

Example:

a. 0100110010001111

b. 0100 1100 1000 1111
   4 12 8 15

c. Replace numbers greater than nine with the HEX alpha-value.
   4 12 8 15
   4 C 8 F
   $0100110010001111_2 = 4C8F$

### Hexadecimal to Binary

Here we will use the same HEX number $4C8F_{16}$. But reverse our process above.

Example:

a. 4 C 8 F

b. 4 12 8 15

c. 0100 1100 1000 1111

d. $0100110010001111_2$

The conversion methods shown are for illustrative purposes and are not meant to construe "the only way to fly." Conversion tables may be utilized for the sake of expediency. Although not illustrated, fractions may also be converted from one system into another.

## BINARY ARITHMETIC

Since we are working with only two digits, let's set up some rules for binary addition.

a. 0 + 0 = 0

b. 0 + 1 = 1

c. 1 + 0 = 1

d. 1 + 1 = 0 carry 1 to the next column

Examples:

| 10 | 101 | 1 1 | 1111 |
|---|---|---|---|
| +10 | +010 | +1 | + 11 |
| 100 | 111 | 11 | 10010 |

### Subtraction By Addition of Complement

A problem in subtraction can be converted to a problem in addition by adding the complement of a number instead of subtracting the number itself. The complement of a number is the difference between that number and a reference number. As an example: if the reference number is "9", the complement of "6" is "3"; the complement of "7" is "2", and so on.

Below is an illustration of the method which is used to perform subtraction, by the process of addition, using the "nines complement."

| (Minuend) | 8 | (Augend) | 8 | 4 | |
|---|---|---|---|---|---|
| (Subtrahend) | 3 | (Addend) | 6 | 1 | |
| | 5 | (Sum) | 14 | 5 | (Difference) |

The subtraction of "3" from "8" is accomplished by the addition of "6" (the "nines" complement) to "8". *This addition yields a sum of "4", and a "1" develops in an extra column. When the extra "1" is added to the "4", a final answer of "5" results.*

An identical method is used for the subtraction of binary numbers except that the "ones complement" is used instead of the "nines complement." To effect the "ones comple-

ment" of a binary number, all the zeroes are changed to ones and all the ones are changed to zeroes.

First, we will give the summary of the rules for direct binary subtraction, and then show how subtraction of binary numbers is accomplished by the complement method.

**Summary of Rules for Binary Subtraction**

a. "0" minus "0" equals "0" with no borrow
b. "1" minus "1" equals "0" with no borrow
c. "1" minus "0" equals "1" with no borrow
d. "0" minus "1" equals "1" with a borrow of "1"

DIRECT METHOD

```
Minuend      11010
Subtrahend   10101
             -----
             00101
```

COMPLEMENT METHOD

```
                Minuend      11010
              Subtrahend     01001
                             -----
                             100100
END AROUND CARRY             1     ADD
                             -----
                             00101
```

Note that, in the direct method, we used the above rules for binary subtraction which yielded a result of "00101". In the complement method, we changed the 1's of the subtrahend to 0's and the 0's to 1's and then applied the rules for binary addition. This addition yielded a sum of "00101", and a "1" developed in the extra column. When the extra 1 was added to the "00100", a final answer of "00101" resulted, which is the same result that we obtained by the direct method.

In a computer, the ones complement of a number held in a storage register can be easily generated by application of a pulse to reverse all of the stages in the 0 condition switch to 1 and all of the stages in 1 condition switch to 0.

Employment of the subtraction by addition of complements in the computer permits the use of the same circuits for both addition and subtraction.

In using the ones complement, a positive answer is indicated if there is end around carry; if there is no end around carry, this indicates the answer is negative, and in complemented form. To get the true answer we have to take the ones complement and prefix the negative sign.

Example: Subtract 1111 from 1100

(a)

```
 1100
-1111
-----
```

(b)

```
 1100
+0000
-----
 1100   No end carry
```

(c)

```
Complement  1100
           -0011   True Answer
```

**Two's Complement Method**

The previous complement method is called the one's complement method. The ones complement is where we change all ones to zeroes and all zeroes to ones. The two's complement of a number is found by first taking the one's complement then adding one.

Example:

(a)

```
1100
0011  one's complement
   1  add one
0100  two's complement
```

(b)

```
1100  one's complement
   1  add one
1101  two's complement
```

Subtraction (two's complement method)

(a)

```
1000
1110
----
```

(b)

```
1000   2's comp
0010
----
1010
```

(b)

```
1100
1000
----
```

```
1100   2's comp
1000
----
10100
```

Once again an end carry indicates the answer is positive and in true form. If there is no end carry indicated, the answer is negative and in 2's complement form. To get the true answer, we have to take the 2's complement of the indicated answer and affix the negative sign. In our example (a) of subtraction, taking the 2's complement, 2's complement of 1010 = 0101 + 1 = −100, our answer ends up a −6.

**Binary Multiplication**

The rules for binary multiplication are very simple. They are given as:

a. "0" times "0" equals "0"
b. "1" times "0" equals "0"
c. "1" times "1" equals "1"

Binary numbers are multiplied as in decimal notation.

Example:

```
 011
 011
-----
 011   (1st partial product)
011    (2nd partial product)
-----
1001
```

Note: This is the binary equivalence of the decimal multiplication of "3 × 3." Although it is quite simple to perform binary multiplication by means of pencil and paper, it is not easy to incorporate in a computer. A number involving three or more digits would necessitate adding three numbers whereas the adder is capable of adding only two numbers at a time. Also, there is the possibility that two or more carries may be generated in an order.

One possible method would be to add the multiplicand to itself the number of times specified by the multiplier. Thus,if "115" is to be multiplied by "23", "115" could be successively added 23 times. This, of course, would be a rather lengthy method. A shorter method for a solution to the same problem would be to add "115" three times as indicated by the units digit of the multiplier. The tends digit of the multiplier indicates that twenty more additions are to be performed; however, the multiplicand digit may be shifted left one place with respect to the accumulated sum before being added to itself.

Shifting the multiplicand digit to the left is equivalent to multiplication by ten. Hence, "115" must be added only twice and shifted left to satisfy the required 20 additions. This method is shown as follows:

```
000  0
115  0
-----
115  0
115  0      Add 115, 3 times
-----
230  0
115  0
-----
345  0
-----
034  5      Shift right
115  0
-----
149  5
115  0      Add 115, 2 times
-----
264  5      Product
```

Note: The partial product (the sum of the first three additions) is shifted to the right instead of the multiplicand being shifted to the left.

Examples: Multiplication

(a)

```
  1001
  1101
 ------
  1001
 0000
1001
1001
-------
1110101
```

(b)

```
   111
    11
 -----
   111
  111
-----
 10101
```

**Binary Division**

Binary division can be accomplished by the pencil and paper method, the same as is accomplished for decimal division. Thus:

```
        11
101   1111
      101
     ----
       101
       101
     ----
```

Division can also be performed by successive subtraction. An example in decimal notation "15" could be divided by "5" by subtracting "5" from "15" and successively subtracting "5" from the differences until a zero is obtained. This can also be accomplished using binary notation. Thus, binary "1111" can be divided by binary "101" by means of three successive subtractions. Thus:

```
1111
 101   1st subtraction
----
1010
 101   2nd subtraction
----
 101
 101   3rd subtraction
----
 000
```

**Summary of Rules for Binary Division by Subtraction**

a. Each time a subtraction leaves a positive remainder, a "1" is placed in the quotient
b. Each time a subtraction leaves a negative remainder, a "0" is placed in the quotient
c. The remainder is shifted left one place with respect to the divisor after each subtraction

Following these rules, the example which we have used above could be solved in the manner indicated below:

| | | |
|---|---|---|
| Dividend . . . . . | 1111 | Quotient |
| Divisor . . . . . | 1010 | (Complement 0101) |
| Remainder . . . . . | 0101 | 1 |
| Shift remainder left . . . | 1010 | |
| | 1010 | |
| | 0000 | 1 |

When this method is compared with the first, or the pencil and paper method, it is seen that the relative positions of the divisor and the dividend are the same for both methods. In the pencil and paper method, "101" is first divided into "111" (the three most significant bits (MSBs) in the dividend). In this method, "101" is first subtracted from the three MSBs since they are divisible by "101".

Since the divisor is smaller in value than the first three digits, the first quotient bit is a "1".

In the pencil and paper method, the remainder resulting from the first subtraction is "10", and the next dividend digit is brought down so that the remainder is "101". When the divisor is divided into this remainder, the result is a "1". In this method, the same relative position of the divisor and the remainder must be maintained; so the remainder is shifted left one place before the next subtraction is made. Since the divisor is not larger than the remainder, the quotient bit is again "1".

**Negative Remainders**

Rule B of the summary for Binary Division by Subtraction refers to negative remainders, but in the previous example there was no "0" generated in the quotient. We shall take another example and demonstrate what must be done when a 0 is generated. First, we shall show the pencil and paper method when binary "101101" is divided by binary "1001".

```
      101
1001 / 101101
       1001
      -----
        1001
        1001
      -----
```

Here it is seen that, after the first division, bringing down the next digit will yield a remainder which is smaller than the divisor; so we place a "0" in the quotient. Thus, when the next digit is brought down, the remainder is not smaller than the divisor.

The successive-subtraction method is demonstrated as follows:

| | | Quotient |
|---|---|---|
| | 101101 | |
| Subtract . . . . . | 100100 | |
| | 001001 | 1 |
| Shift . . . . . | 010010 | |
| | 100100 | |
| | 101110 | 0 |
| Restore-add . . . . . | 100100 | |
| | 010010 | |
| Shift . . . . . | 100100 | |
| | 100100 | 1 |

The result of the first subtraction is a positive number, but when this number is shifted left it is still smaller than the divisor. If subtraction were performed, it would result in a negative number.

The problem which must be met lies in the fact that a computer has no way of knowing that the divisor is smaller than the remainder until subtraction has been performed. One indication is that the highest order will require a borrow. This excess borrow is referred to as an "overdraw."

In the event that an improper subtraction is performed, the remainder must be restored to its original value before the next dividend is used. This is accomplished by adding the divisor to the remainder before the next shift occurs.

## SCALING

A computer is generally capable of handling a wide range of numbers, and one method which is employed to provide this versatility is known as "scaling." This involves altering the units in which all variables are expressed so as to bring all magnitudes within the capacity of the computer.

In the scaling method, all of the numbers which the computer is called upon to handle are treated in a manner which is similar to the power-of-ten notation; that is, $4 \times 10^2 = 400$, $4.5 \times 10^3 = 4{,}500$, etc. However, since the computer functions as a binary machine, the powers-of-two rather than the powers-of-ten are utilized.

If the binary number 11001 (decimal 25) is to be programmed, it would be expressed as $0.11001 \times 2^5$. This means that when a problem is programmed, the exponents have to be accounted for. Exponents have to be the same before addition and subtraction may be accomplished, and they

have to be added during the multiplication process and subtracted during division.

When scaling is utilized, the computer incorporates provisions for shifting right and shifting left. Although the study of number systems, methods of conversion and the related arithmetic processes is quite a specialized field in itself, the amount of material presented here will suffice for the understanding of arithmetic logic circuits at a later date.

## LOGIC

The dictionary defines logic "as the science of correct reasoning; valid induction or deduction." The word logic has been synonomous with the name of Aristotle, Greek philosopher, down through the ages. However, it wasn't until 1853 that George Boole wrote his book, *An Investigation of the Laws of Thought* on which are founded the mathematical theories of logic. In the following discussion of "Logic Elements" we are relating these theories to electro-mechanical/electronic components.

## LOGIC ELEMENTS

Digital computers are built by interconnecting a relatively small number of basic circuits. Usually, these circuits are represented by means of symbols. The larger the system, the more desirable it is to represent its operation by means of symbols in a functional block diagram.

### Block Diagrams

Functional block diagrams are of great importance in designing computers, in that complete systems can be arranged by means of block diagrams even before circuit breadboards are built. The troubleshooter also relies heavily upon the use of block diagrams, because his major problem is to localize a fault in one section and then in one IC of a complex system.

### Basic Logic Elements

The manipulation, routing and general processing of such binary data representing alphabetical or numerical characters under the control of binary signal commands or conditions is performed essentially by a few basic logic elements. Among these, the most important are the AND gate, OR gate, signal inverter and flip-flop.

### Auxiliary Units

In addition, there are units such as power amplifiers, and transducers of various kinds to convert mechanical into electrical signals — that are essential, but which do not perform logic operations. There are also memory devices which have the capacity to store large numbers of binary bits, but they serve only as storage devices. All of these other units and devices will be discussed at a later time, for the present we will confine our discussion to logic elements and their combination.

## LOGIC ELEMENTS RELATED TO SWITCHES

In electronic digital equipment, as well as in any other digital control system, many of the circuits function as high-speed switches. The operations performed by these circuits could also be performed by mechanical switches and relays, but only at a considerable sacrifice in operating speed.

Electronic switching circuits can be designed to operate at frequencies of several megaHertz. These switching circuits, because they produce output signals only when certain input conditions exist, are often referred to as logic gates or decision elements.

All the operations performed by logic gates can be described by using the conjunctions OR, AND, OR NOT, and AND NOT — all of which are easily reproduced by electronic or electromechanical means.

## "OR" CONCEPT

The first conjunction listed is the word "OR". But the concept merits certain clarification.

### Exclusive and Inclusive Concept

In our everyday life, we use the word "or" so frequently that we are not aware of the fact that this word has two meanings. That is, when someone tells us "tomorrow afternoon I will go to the baseball game or to the movies," we understand that this person is going to one of these two places but not to both.

If someone should ask us how we know this, we would say the word "or" indicates this fact. However, this meaning of the word "or" is not always true, because if before we leave on a trip someone tells us to check our car and replace the broken

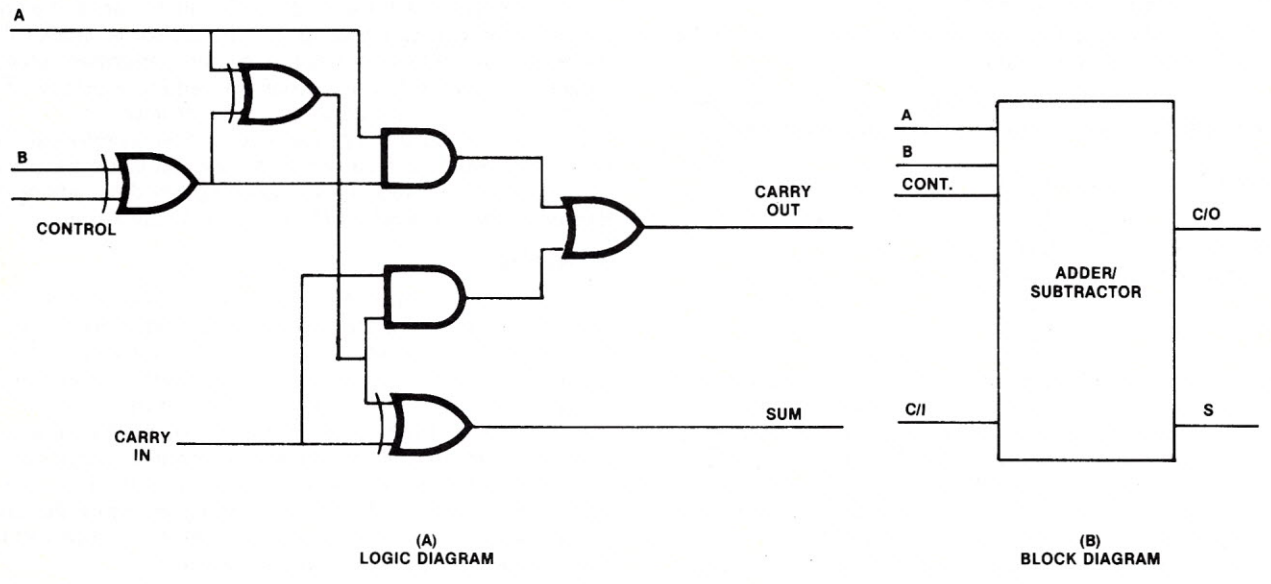



**Figure 45. Full Adder/Subtractor**

or worn out parts, we understand that the parts which are broken and also the parts which are worn out must *all* be replaced.

The explanation for the difference in understanding exists in the fact that, in the first example, we give to the word "or" an exclusive concept; that is, "A" or "B" but not both. On the other hand, in the second example, we give to the word "or" an inclusive concept; that is, "A or B or both." The general meaning of the sentence enables us to understand the concept given to the word "or."

### Need For Precise Meaning

The situation is different in the case of a machine. Machines do not know the general meaning of a sentence and, therefore, the concepts we give to them must be clear and well defined in order for the machines to work properly.

What is done, whenever a precise language is needed, is to *use symbols.* There are two types of symbols in use; some from logic, and used by logicians; the others, commonly used by engineers, taken from mathematics. In the latter case, the word "OR" is represented by the plus sign, +, and, by definition, its inclusive meaning is accepted. That is, A + B means A or B or both at the same time. The reason for this will be explained later. The "exclusive OR" is identified by the symbol 5.

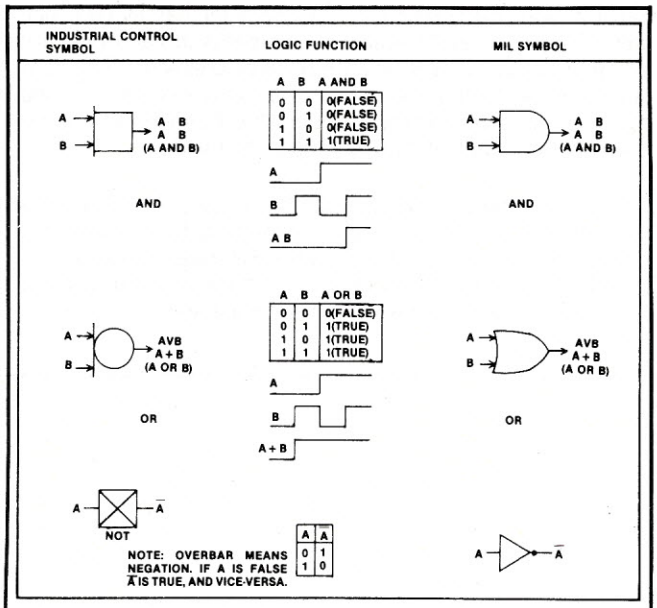



**Figure 46. Equivalence of industrial control and military symbols.**

### "AND" CONCEPT

The second conjunction listed is the word "AND." The "AND" concept has only one meaning, that is, the expression "A and B" means A and B at the same time.

So we can say that a bank draft is valid only when: the amount in letters L, the numbers N, and the signature S, are properly placed in it. The word *and* signifies that all these factors are indispensable and that the absence of only one of them invalidates the draft.

The word *and* is represented by the sign of multiplication. So, the bank draft is valid only when it contains L × N × S, or LNS, eliminating the multiplication sign as in algebra.

### Relays Used for Simplification

The use of the AND and inclusive OR concepts as a basis of all logic structures offers the tremendous advantages that they can be reproduced by simple switching circuits using relays, diodes, transistors or magnetic core elements.

In the examples that we will present here, we will use relay contacts for the sake of clarity to explain the operation of logic circuits. However, the same but faster results are obtained by using electronic switching systems.

## AND GATE CONCEPTS

To understand the AND and OR concepts in their practical applications, we will start with an example of an AND gate.

### Relay System

For this example, we will employ the automatic elevator of a building provided with a call button A at the first floor and a safety button B at the door. In order for the elevator E to operate, button A must be depressed and button B must be closed.

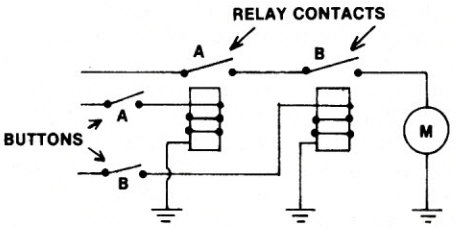



**Figure 47. "AND" gate, using relays.**

The control of the elevator is obtained by employing two relays as shown in Figure 47. When button A is depressed, the circuit through the coil of relay A is closed; and when button B is closed, the circuit through the coil of relay B is also closed. The contacts actuated by these two relays are connected in series. Therefore, only when both relay contacts are simultaneously closed is the motor M energized. Then A and B (AB) is equivalent to the connection of the contacts or variables, in series.

The circuit could be designed so that the elevator motor would be energized even if the relay contacts were closed (on) for a very short instant; that is, if both coils received short-duration pulses instead of a continuous amount of current. In this case, however, both relays would have to receive their pulses simultaneously in order for both to be closed at the same time and so operate the motor.

## NEXT MONTH

This unit concludes in May with a general overview of additional logic elements and Boolean Algebra with its application towards these same elements. The questions and answer card will appear next month.

## ERRATA: Unit No. 1, January

Page 74

Reads: "would have cost at least a $1,000,000,000"

Should Read: "would have cost at least a $1,000,000"

Page 84

Reads: $X_C = \frac{1}{2fc}$

Should read: $X_C = \frac{1}{2pfc}$

Reads: $Fr = \frac{1}{2p\ LC}$

Should read: $Fr = \frac{1}{2p\ LC}$

## ANSWERS AND LETTERS

In response to letters regarding the first installation of this series, this rule regarding the direction of the magnetic field may be helpful. The right hand rule is observed when using 'conventional current flow' and the left hand rule when using 'electron flow'.

For others who write, please be specific in your questions so we can better answer them.□

# Programming Technique

By Bill Turner, Senior Editor Southeast Region

Last month we discussed the serial port. Serial transmissions, you should remember, are generally used when the terminal is going to be more than a few feet from the computer. Serial transmissions are very economical over long distances, because only two data paths are required. A transmission path is required from point A to point B, and a separate path is required for transmissions from point B back to A. When both paths can be used simultaneously, the circuit is called a full-duplex circuit. A half-duplex circuit gives you the ability to transmit in both directions but not at the same time (Figure 1).

Therefore, it is possible, when using transmission speeds of less than 1200 baud (roughly 120 characters a second), to provide a full duplex communications circuit over the same physical telephone circuit. This is the primary form of communication used between a terminal and a time sharing system. A MODEM is used in this type of system, to convert the electrical pulses used by the computer and terminal into audio tones for transmission over the long distance network.

One of the disadvantages of serial transmission is the lack of ability to provide a true and absolute form of 'handshaking.' Handshaking is the process whereby the transmitting device puts data on a bus and into a buffering device, and waits for the data pulses to settle down. Then, over a separate data path, it tells the receiver some new data is available. The receiver loads the data from the buffer and then tells the transmitter "I got it, send another byte." Some time period later the transmitter and receiver repeat the process. Should either the transmitter or receiver need some additional time, it just takes the time to do the job properly. When the receiver is ready to receive another byte, it acknowledges the receipt of the previous byte. In cases where the transmitter needs additional time to create a data byte, it waits until the byte is fully formed before telling the receiver "a new data byte now ready; read it when you can. . ."

This month we are going to talk about a transmission method which is much faster than those obtainable by serial devices. This "other" form of transmission is called parallel transmission. Each data bit in a character has its own data path. Therefore, eight separate data paths in each direction will be required to transmit an 8-bit wide character. The computer bus or motherboard is a good example of a parallel data bus. In most microcomputers the bus structure is between 50 and 125 data bits (data paths) wide.

A form of a parallel transmission bus is used in most control applications, or any application requiring high-speed data transfer. As you will see shortly, a parallel transmission usually provides for handshaking between the transmitting device and the receiving device; this provides device synchronization.

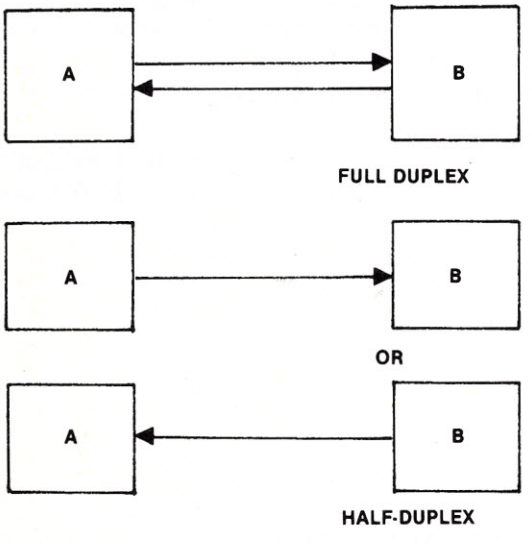



**Figure 1. Examples of half and full duplex.**

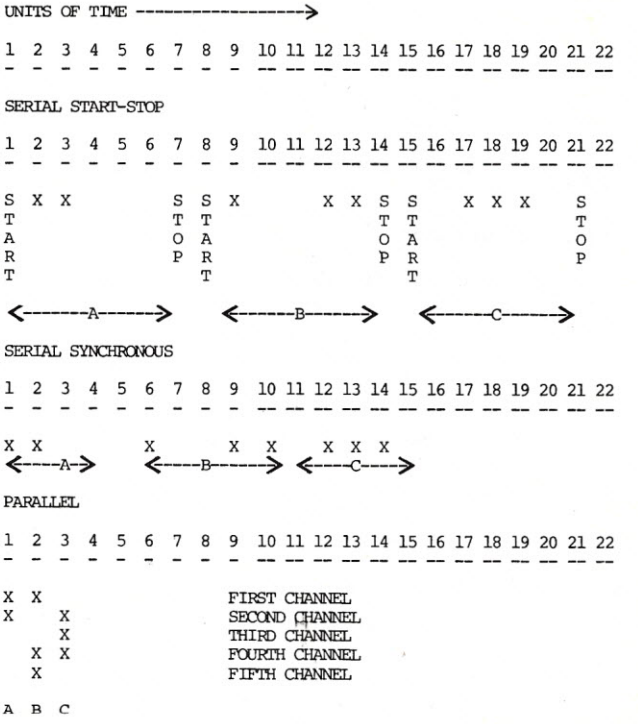



**Figure 2**

# Night 4

You will also find that the parallel port, or Peripheral Interface Adaptor (PIA), is one of the key elements in most input/output systems for microcomputers.

We will start the discussion by describing the Motorola 6820 PIA, as it is typical and can be found in most microcomputer systems. Following the discussion on the 6820 we will then examine the Intel 8155. This circuit is very unique and was designed for the Intel 8085 to reduce the overall parts counts (and cost!).

## 6820 PIA

The 6820 can be used to interconnect flip-flops, buffers, and other logic circuits to a microcomputer. The PIA provides all the necessary buffering and signal translation as needed for the specific application at hand. The PIA can be dynamically configured or re-configured by software to interface with either positive or negative going logic pulses. Also, the PIA can be programmed to respond to the leading or trailing edge of a synchronization pulse. Programming the PIA is done by loading data values into the PIA's control and data direction registers.

The control register is used to define the operating environment — exactly what the control will be; interrupts, etc.

The data direction register is used to define each of the 16 data lines, and to configure them as either an input or output data line.

Figure 3 is a functional diagram of a PIA. The device contains two nearly identical 8-bit ports. The "A" port which is usually defined as 8-bits of input data, and the "B" side, which is usually defined as 8-bits worth of output data. Remember, this usage is only a recommendation; you may wish to consider other input/output configurations. In fact, the device will actually allow you to define some bits in a port as input data lines, and the rest of the bits in the same port as output lines.

Each of the 8-bit ports occupy two addresses; the first is shared by both the data direction and the data port registers; the second is the control register.

The PIA, therefore, actually occupies 4 contiguous memory address (memory mapped I/O) or 4 contiguous I/O port addresses (I/O device mapping). The first two addresses are used by side "A", and the last two addresses are used by side "B".

Any data written to the first address of either port will go to the data direction register if bit 2 of the control register was set to a zero. If, instead, bit 2 was set to a one, then any data written to the first address would go to the data register, and would in turn be presented to the peripheral device if any data lines were defined to be output lines.

The PIA also supports two handshake lines — these are identified as CA1 and CA2 on the "A" side, and CB1 and CB2 on the "B" side. Refer to Figure 1. You will see that CA1 is used as an input signal and that CA2 may be used as either an input or output signal. Normal operation is to use CA2 as an output signal. CB1 and CB2 are used and defined in exactly the same manner for the "B" side.

You must store a byte into the control register (first address of either side) to define the operating parameters for the CA1 and CA2 (CB1 and CB2) control lines, as well as to define the status of the interrupt system.

This byte should have bit 2 set to a '1' so that the data port will be switched internally to the peripheral data bus.

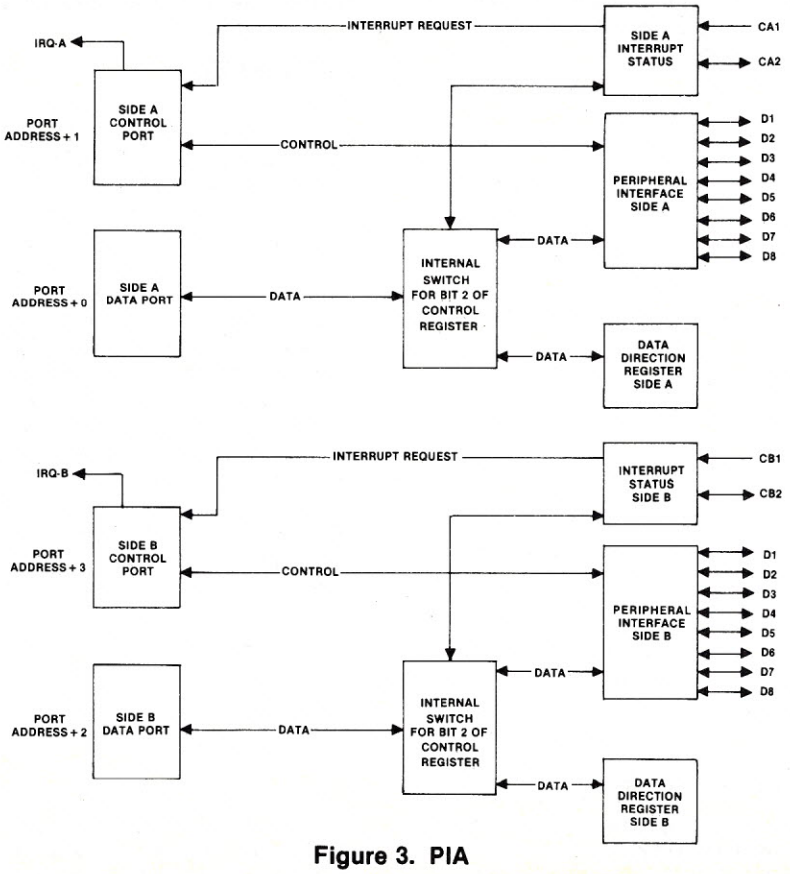



**Figure 3. PIA**

## CA1 INPUT CONTROL SIGNAL INITIALIZATION

Bit 1 of the control port specifies how the CA1 line is to cause control bit 7 to be set to a '1'.

Bit 7 will be set when bit 1 = '0' on a high-to-low transition of CA1. Bit 7 can be set by a low-to-high transition of CA1 if bit 1 is initialized to a '1'. Bit 0 when set to '0' will not allow the CA1 line to create an interrupt, but if set to a '1' will allow the CA1 control line to cause an interrupt at the same time that it causes bit 7 to be set.

## CA2 INITIALIZATION

Bits 3, 4, and 5 of the control port control the status of the CA2 control line. Bit 5 defines the CA2 control line as either an input (bit 5 = '0') or an an output (bit 5 = '1').

## CA2 DEFINED AS AN INPUT SIGNAL

If bit 5 is defined as a '0' then bit 3 is used to control the interrupt system: bit 3 = '0' disables CA2's ability to cause an interrupt. Bit 3 = '1' will allow CA2 to create an interrupt at the same time the CA2 line causes bit 6 to be set.

Bit 4 is used to specify when control bit 6 is to be set as the result of a transition on CA2. Bit 4 = '0' causes CA2 to be sensitive to a high-to-low transition, and bit 4 = '1' causes it to be sensitive to a low-to-high transition. CA2 initialized as an output control signal. CA2 will be defined as an output signal whenever bit 5 is set to a '1'.

There are two ways that can be used to control CA2 when it is being used as an output signal from the CPU to the peripheral device. The first is to control the status of the CA2 line under total program control. I usually refer to this as "manual" control as opposed to the second form which is "automatic."

Bit 4 is used to specify whether control is to be "manual" (bit 4 = '1') or "automatic" (bit 4 = '0'). When you are controlling the status of CA2 "manually," bit 3 specifies the exact state of CA2: When Bit 3 = '0' CA2 will go low, when bit 3 = '1' CA2 will go high.

Therefore, if you need to have the CA2 signal line to present a normally low signal, and to pulse the line high for 30 microseconds and then take it back low again, you would need to follow the following steps:

1. Initialize the control port as follows:
   bit 5 = '1' (CA2 defined as output)
   bit 4 = '1' (control CA2 "manually")
   bit 3 = '0' (set CA2 low)
2. When ready to pulse the CA2 line high:
   bit 3 would need to be set to a '1'
3. Using some form of delay loop, wait for 30 microseconds and then:
   bit 3 would need to be set back to a '0'

Remember: Bits 0 to 2 and 4 to 7 must not change!

If bit 4 was set to a '0', then the control of CA2 will be "automatic."

If bit 3 is set to a '1', then CA2 line will automatically be pulsed immediately following a read of the data register. The pulse is generally 1 system clock pulse in length. The normal state of the CA2 line will be a high logic state. The pulse will be a high-to-low transition for one clock period.

If, however, bit 3 is set to a '0', then the CA2 line will be automatically set to a low state immediately after the read of the data register. The CA2 line will remain low until the next active CA1 transition. After CA1 has changed state then CA2 will remain high, until the read is performed, at which time CA2 will go low again, and so forth.

Complex? You bet! However, the same complexity is also great flexibility, and as a result the 6820 can be interfaced to virtually any type of peripheral device.

```
PIAINIT LDX PORT   SET THE INDEX REG TO STARTING ADDRESS
*
*   SET UP ACCESS TO DATA DIRECTION REGISTER,
*       DO NOT ASSUME SYSTEM RESET HAS OCCURED YET.
*
        CLR 1,X     RESET THE CONTROL PORT FOR SIDE "A"
        CLR 3,X     RESET THE CONTROL PORT FOR SIDE "B"
        CLR 0,X    SIDE "A" NOW CONFIGURED FOR INPUT
        CLR 2,X    SIDE "B" NOW CONFIG. FOR INPUT
        COM 0,X    TURN BITS UPSIDE, SIDE "A" NOW
*                    CONFIGUREED FOR OUTPUT.
*
*   CONFIGURE SIDE "A":
*   CA2 = HOLD PERMINENTLY HIGH
*   ACCESS TO DATA REGISTER
*   CA1 TO WATCH FOR LOW-TO-HIGH TRANSITION.
        LDAA $3E
        STAA 1,X    STORE IT INTO SIDE 'A'
*
*   CONFIGURE SIDE "B":
*   CA2 = AUTOMATICALLY PULSE CA2 ON READ, RESTORE
*             ON NEXT INSTRUCTION CYCLE.
*   ACCESS TO DATA REGISTER
*   CA1 TO WATCH FOR LOW-TO-HIGH TRANSITION.
        LDAA 2E
        STAA 3,X     SIDE "B" NOW INITALIZED
        RTS
```

**6800 Initalization Code for 6820 PIA**
**Example 1**

Example 1 is a representation of the type of code that can be used to initialize side A to be an 8-bit input port and side B to be an 8-bit output port. Although the example is for a 6800, the same logic is used for 8080/8085 systems.

A system reset clears all internal PIA registers, which causes all data lines to be defined as inputs, and causes the data port address to be internally connected to the data direction register. If it is desired to define all eight bits as outputs then you must store a byte of all ones (hexadecimal FF or $FF or OFFH) into the "data port" of either side "A" or "B". It is recommended, however, that you not assume that the PIA has been reset, and that you use code similar to that in the example.

## INTEL 8155

The 8155 is a very unique device. It was designed to support the 8085 with three different functions, all rolled up in the same package. The 8155 has two complete 8-bit I/O ports, a single 6-bit I/O port, 256 bytes worth of static memory, and a programmable 14-bit binary counter/timer.

The first two ports, port "A" or port "B" can be programmed for 8 bits input, or 8 bits output, but cannot be split as in the Motorola 6820 PIA. Port "C" is 6 bits wide and is usually used as status bits for ports "A" and "B" in much the same manner as the CA1/CA2 lines in the Motorola 6820 circuit. If desired, however, port "C" can be configured as an additional 6-bit wide input/output port.

The circuit is quite flexible, and provisions have been made to be able to specify whether ports "A", "B", or the time can control the interrupt line.

One very important thing to keep in mind is that the 8085 only requires a 5 volt power supply, rather than the three separate supplies (+5, +12, −12) that the 8080 required. The 8085 system was intended to be used where package density and package counts mattered, such as in a control system.

Unfortunately, space does not permit me to go into great depth on the 8155. But if you can follow the logic and use of the 6820, you will not have any problems with the Intel 8155. Its great advantage is the three separate devices in the same package.□

*If you have a question about programming, or system software design, the author can be contacted by writing or calling, Bill Turner, Senior Editor Southeast Region, 3316 San Luis, Tampa, FL 33609, (813) 839-3972.*




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- Handsome Plastic Case

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Low price includes KIM-1 Module, monitor programs stored in 2048 ROM Bytes, User Manual, wall size Schematic, Hardware Manual, Programming Manual, Programmers Reference Card, Keyboard, Display

## THE SYM-1 $245

**6502** — based single board computer with keyboard/display, KIM-1 hardware compatible, complete documentation.

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| | |
|---|---|
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| 8251 | $ 7.50 |
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| 1702A | $ 8.00 |
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|---|---|---|
| 21L02 (450ns) | $ 1.50 | $ 1.20 |
| 21L02 (250ns) | $ 1.75 | $ 1.50 |
| 2101-1 | $ 2.95 | $ 2.60 |
| 2111-1 | $ 3.25 | $ 3.00 |
| 2112-1 | $ 2.95 | $ 2.65 |

| | |
|---|---|
| **FLOPPY DISK CONTROLLERS** | |
| 1771B01 | $39.95 |
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| AY5-2376 | $13.75 |
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### Naked Terminal

FEATURES & BENEFITS

- Industry standard 80 character by 24 line format (Model 57)
- Completely self contained terminal electronics, just add CCTV monitor and keyboard.
- No support software required.
- Switch selectable modes: Half Duplex, Full Duplex, Block mode.
- Block mode allows editing before transmit.
- Keyboard interface provided, including regulated +5 volts and -12 volts.
- Video is switch selectable as "Black-on-White" or "White-on-Black".
- Fully assembled, socketed, tested, burned in, and guaranteed for a full year from date of purchase.

**$350.00 with cables**

## NEW!

### JADE Z80 BOARD

**IMPROVED DESIGN AND FEATURES**

- ON BOARD 2708 or 2716 EPROM
- VERY RELIABLE AT 4 MHZ OR 2 MHZ
- POWER ON JUMP AND RESET
- ON BOARD USART (8251)

| 2MHz | |
|---|---|
| Kit | $135.00 |
| Assembled & Tested | $185.00 |
| **4 MHz** | |
| Kit | $149.95 |
| Assembled & Tested | $199.95 |
| Bare Board | $ 35.00 |

### JADE BOBOA

with full documentation

| | |
|---|---|
| Kit | $100.00 |
| Assembled & Tested | $149.95 |
| Bare Board | $ 30.00 |

### EPROM BOARD KITS

JG8/16 (uses 2708 or 2716) **$69.95**

## Jade Memory Expansion Kits for TRS-80 and Apple!

4116's

**8 for $69.96**

(16K x 1, 200ns)

includes dip plugs and instructions

**★TRS-80 Kit ★**

(16K x 1, 300ns)

includes connectors and instructions

**$75.00**

Call for discounts on larger quantities

**"IMSAI"-TYPE CARD GUIDE SPECIAL:**

Regular Price 30¢ each

**SPECIAL: 10 for $1.00!**

## Rockwell AIM-65: The Head-Start in Microcomputers

A KIM-1 compatible machine with on-board printer and a real keyboard!

**$375.00 w/1K RAM**
**$450.00 w/4K RAM**

| | |
|---|---|
| 4K assembler/editor in ROM: | $ 80.00 |
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| Power supply: | $ 59.95 |
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**Special Package Price: $599.00**

AIM-65 (4K), Power Supply, Case, and 8K BASIC ROM

## KIMSI

INTERFACE/MOTHERBOARD

Makes S-100 cards plug-in compatible with KIM!

| | |
|---|---|
| Kit | $125.00 |
| Assembled & Tested | $165.00 |

## BETSI

INTERFACE/MOTHERBOARD

Makes S-100 cards plug-in compatible with PET!

| | |
|---|---|
| Kit | $119.00 |
| Assembled & Tested | $159.00 |

## The Piggy™ is here!



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## TEXTOOL ZIP* DIP® II Sockets



***ZERO INSERTION FORCE sockets**

| PRICES: | |
|---|---|
| 16 pin Zip Dip II | $5.50 |
| 24 pin Zip Dip II | $7.50 |
| 40 pin Zip Dip II | $10.25 |

## New Prices

### DYNAMIC RAM BOARDS EXPANDABLE TO 64K

**32K VERSION • KITS**

Uses 4115 (8Kx1, 250ns) Dynamic RAM's, can be expanded in 8K increments up to 32K:

| | |
|---|---|
| 8K $159.00 | 24K $249.00 |
| 16K $199.00 | 32K $299.00 |

**4115 SALE 8 for $39.95**

**64K VERSION • KITS**

Uses 4116 (16Kx1, 200ns) Dynamic RAM's, can be expanded in 16K increments up to 64K:

| | |
|---|---|
| 16K $249.00 | 48K $469.00 |
| 32K $369.00 | 64K $569.00 |

## ★ STATIC RAM SPECIALS ★

**2114's**, low power (1024x4)

| | 1-15 | 16-99 | 100 + |
|---|---|---|---|
| 450ns | 8.00 | 6.95 | 5.50 |
| 300ns | 9.00 | 8.00 | 6.50 |

**TMS4044/MM5257**, low power

| | | | |
|---|---|---|---|
| 450ns | 8.00 | 7.50 | 6.50 |
| 300ns | 9.95 | 8.75 | 8.00 |

**4200A** (4Kx1, 200ns)

| | | |
|---|---|---|
| 9.95 | 8.50 | 8.00 |

**410D** (4K x 1, 200 ns)

| | | |
|---|---|---|
| 8.25 | 7.00 | 6.75 |

## JADE Computer Products

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Cash, checks, money orders, and credit cards accepted. Add freight charge of $2.50 for orders under 10 lbs. and $1.00 service charge for orders under $10.00. Add 6% sales tax on all parts delivered in California. Discounts available at OEM quantities.

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All prices subject to change without notice.

## STATIC RAM BOARDS

**JADE 8K**

| Kits: | | |
|---|---|---|
| | 450ns | $125.95 |
| | 250ns | $149.75 |
| Assembled & Tested: | | |
| | 450ns | $139.75 |
| | 250ns | $169.75 |
| Bare Board: | | $ 25.00 |

**16K — Uses 2114's** (low power)

Assembled & Tested:

| | |
|---|---|
| RAM 16 (250ns) | $375.00 |
| RAM 16B (450ns) | $325.00 |

**16K with memory management**

Assembled & Tested:

| | |
|---|---|
| RAM 65 (250ns) | $390.00 |
| RAM 65B (450ns) | $350.00 |

**32K Static**

Assembled & Tested:

| | |
|---|---|
| 250ns | $795.00 |
| 450ns | $725.00 |
| 250ns Kit | $575.00 |

# JADE Computer Products

## ★ DISK DRIVES ★

**B51 5¼"** **$295.00**
by Micro Peripherals, Inc. Operates in either single density (125KB, unformatted) or double density (250KB, unformatted) modes, up to 40 tracks, with a track-to-track access time of only 5 ms.

**SA801R** **$495.00**
by Shugart Single-sided 8" floppy disk drive.

**FD8-100** **$395.00**
GSI/Siemens. Runs cooler and quieter than 801 (8")

**DM2700-S** **$750.00**
Includes SA801R. 10"x10"x16" cabinet, power supply, data cable, fan, AC line filter.

**1791 BO1**
**Dual Density Controller Chip**
**$49.95**

- TWO SIEMENS/GSI 8" FLOPPY DRIVES
- POWER SUPPLY FOR ABOVE
- JADE/TARBELL DISK CONTROL KIT (S100)
- CP/M OPERATING SYSTEM WITH BASIC-E
- PACKAGE OF 10 BLANK 8" DISKETTES

Price if purchased separately: **$1192.50**
JADE SPECIAL PACKAGE DEAL: **$1050.00**

## LOGIC PROBES



Model LP-1
Hand-held logic probe provides instant reading of logic levels for TTL,* DTL, HTL, or CMOS. **Input Impedance:** 100,000 ohms. **Minimum Detectable Pulse:** 50 ns. **Maximum Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.
CSC Model LP-1 Logic Probe—Net Each . . . . . $44.95

MODEL LP-3
High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 ohms. **Minimum Detectable Pulse:** 10 ns. **Maximum Input Signal (Frequency):** 50 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.
CSC Model LP-3 Logic Probe—Net Each . . . . . $69.95

## S-100 MOTHER BOARDS

**JADE 6-SLOT**

| | |
|---|---|
| Kit | $41.95 |
| Assembled & Tested | $56.95 |
| Bare Board | $24.95 |

**9–SLOT "LITTLE MOTHER"**

| | |
|---|---|
| Kit | $85.00 |
| Assembled & Tested* | $99.00 |
| Bare Board | $35.00 |

**13–SLOT "QUIET MOTHER"**

| | |
|---|---|
| Kit | $95.00 |
| Assm. & Tested | $110.00 |
| Bare Board | $40.00 |

**22–SLOT "STREAKER"**

| | |
|---|---|
| Assm. & Tested | $149.00 |

## JADE Products

**"KANSAS CITY STANDARD" TAPE INTERFACE**
Part No. 111
Board $7.60; with parts $27.50

**RS-232/TTL INTERFACE**
Part No. 232
Converts TTL to RS-232 and RS-232 to TTL
Board only $4.50;
with parts $7.00

**RS-232/TTY INTERFACE**
Part No. 600
Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232
Board only $4.50;
with parts $7.00

## 3-LEVEL GOLD WIRE WRAP SOCKETS

| | |
|---|---|
| 14 PIN | 39¢ each |
| 16 PIN | 43¢ each |

100 for $30.00

Sockets are end and side stackable, closed entry.

## JADE VIDEO INTERFACE

S-100 Compatible Serial Interface with Sockets Included.

| | |
|---|---|
| Kit | $117.95 |
| Assembled & Tested | $159.95 |
| Bare Board w/manual | $ 35.00 |

## VERBATIM™ FLOPPY DISKS

**5¼ in. Minidiskettes**
Soft sector, 10 sector, or 16 sector
**$4.40 each or box of 10 for $40.00**
**8 in. Standard Floppy Disks**
Soft Sector
**$4.75 each—10 for $42.50**

## GOLD PLATED S-100 EDGE CONNECTORS



| | | |
|---|---|---|
| Soldertail | | $3.25 each |
| | 10 for $30.00 | |
| Wire Wrap | | $4.50 each |
| | 10 for $40.00 | |

## Z80A SPECIAL

4MHz CPU Chip
☆ $14.95 ☆

## TV-1

Convert your T.V. set into a Video Monitor
Kit $8.95

## JADE PARALLEL/SERIAL INTERFACE

S-100 compatible, 2 serial I/O ports, 1 parallel I/O.
Kit JG-P/S $124.95

Assembled & Tested:
JG-P/SA $179.95

Bare Board w/Manual $ 30.00

## FLOPPY DISK INTERFACE

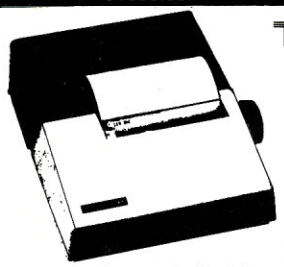
**JADE FLOPPY DISK (Tarbell board)**

| | |
|---|---|
| Kit | $175.00 |
| Assembled & Tested | $250.00 |

**S.D. Computer Products VERSA-FLOPPY**

| | |
|---|---|
| Kit | $159.95 |
| Assembled & Tested | $239.00 |

## TRENDCOM 100 Intelligent Printer



**$345**

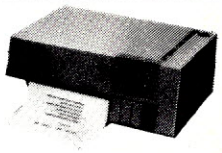
**Interface & Cable for TRS-80 $45.00**

**Interface & Cable for Apple $60.00**

- 40 character per second rate
- Low cost thermal paper
- 96 character set
- Microprocessor controlled
- Bidirectional look-ahead printing
- Quiet operation • No external power supplies • Only two driven parts • High reliability • Clear 5 x 7 characters
- Attractive metal and plastic case

## Integral Data Systems INC

**Check the impressive features on Integral's IP-125 Impact Printer**
only **$799**



**LOADED WITH EXTRAS AT NO EXTRA COST**

• Microprocessor controller • Serial RS232C Interface • Parallel TTL level interface • Full upper and lower case ASCII character set (96 characters) • Full 8½" inch wide paper • Line length of 80 columns at 10 characters per inch • Impact printing • 7x7 dot matrix • Ordinary paper—roll, fanfold, or sheet • Serial baud rate to 1200 bits per second • Multiple line buffer of 256 characters • Instantaneous print rate to 100 characters per second • Multiple copies without adjustment • Reinking ribbon mechanism • Front panel operator controls • Attractive table top console

**IP-125 Integral Data System IP-125 Friction Feed Printer**
- 96 upper & lower case ASCII character set
- Enhanced character control
- Serial RS232C Interface (std. factory wiring)
- Parallel TTL Interface (factory wired on req.)
- 80 column line
- 256 byte multiline buffer

**$799**

**IP-225 Integral Data System IP-225 Tractor Feed Printer**
- All standard features of IP-125
- Tractor feed paper drive
- Forms Control Option (P1250)

**$949**

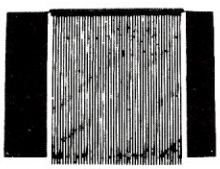
## EXPANDOR'S BLACK BOX PRINTER

This 64-character ASCII impact printer with 80-column capability is portable and uses standard 8½" paper and regular typewriter ribbon. Base, cover and parallel interface are included. Assembled and complete with manual and documentation.
**only $470.00**
(90 day manufacturer's warranty)



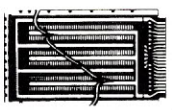
**TRS-80 Interface Cable for Black Box Printer**
with mating connectors: **$48.00**
(must be used with expansion module, +8v/1 amp power supply required.)

**Power Supply for TRS–80/Black Box Printer** **$49.00**



**3690-12 CARD EXTENDER**

Card Extender has 100 contacts, 50 per side on .125 centers. Attached connector is compatible with S-100 Bus Systems . . **$25.00**
**3690 6.5" 22/4 pin. 158 ctrs. Extenders** . . . . . **$12.00**



Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156.

**3677 9.6" x 4.5" . . . . $10.90**
**3677-2 6.5" x 4.5" . . . $9.74**

## Vector Plugboards

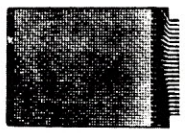
**8800V**

Universal Microcomputer/processor plugboard. Use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16".

**8801-1**

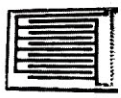
Same as 8800V except plain; less power buses & heat sink.

| | 1-4 | 5-9 | 10-24 |
|---|---|---|---|
| 8800V | 19.95 | 17.95 | 15.96 |
| 8801-1 | 14.95 | 13.46 | 11.96 |



P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156.

**3662 6.5" x 4.5" . . . . . $7.65**
**3662-2 9.6" x 4.5" . . . $11.45**

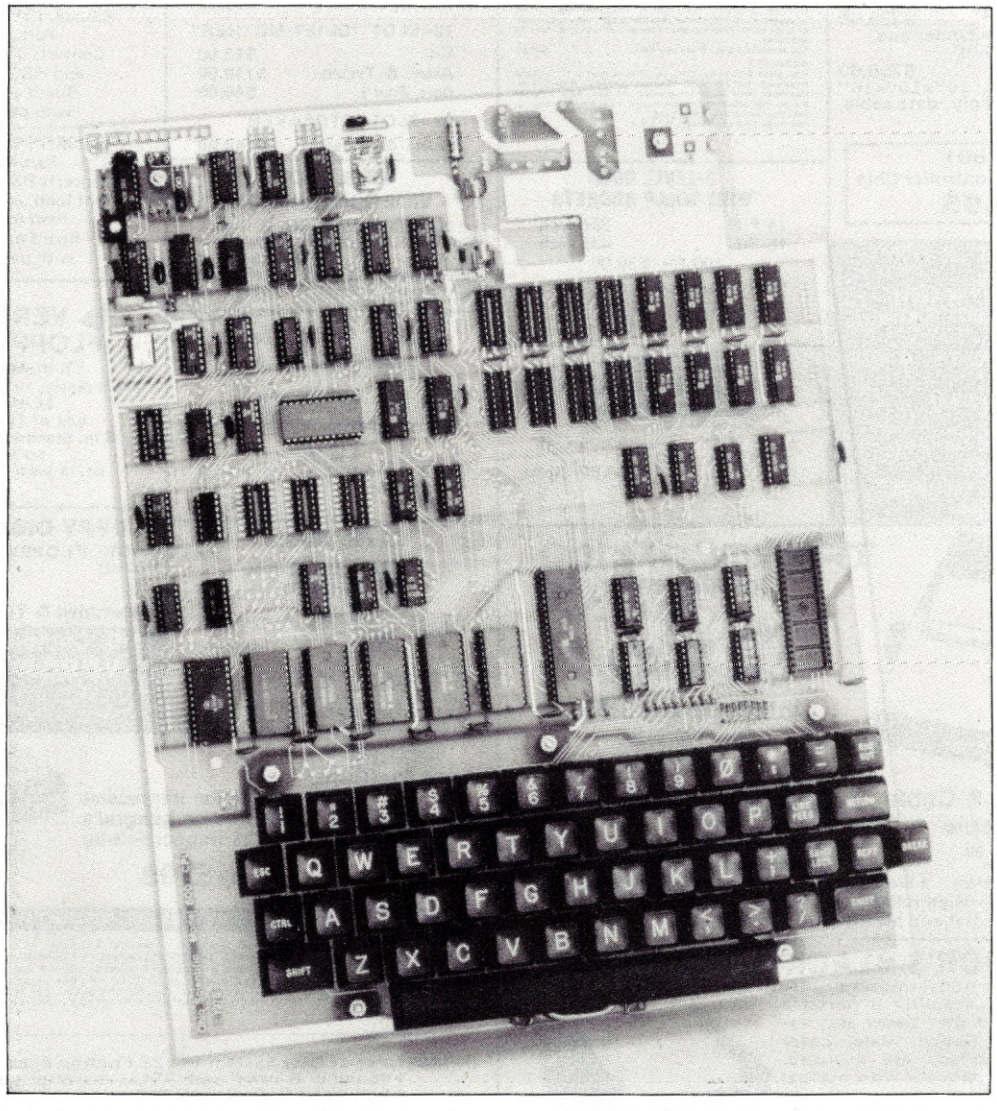


Hi-Density Dual-in-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156.

**3682 9.6" x 4.5" . . . . $10.97**
**3682-2 6.5" x 4.5" . . . . $9.81**

## Card of the Month

# The Ohio Scientific Inc. Single Board Computer



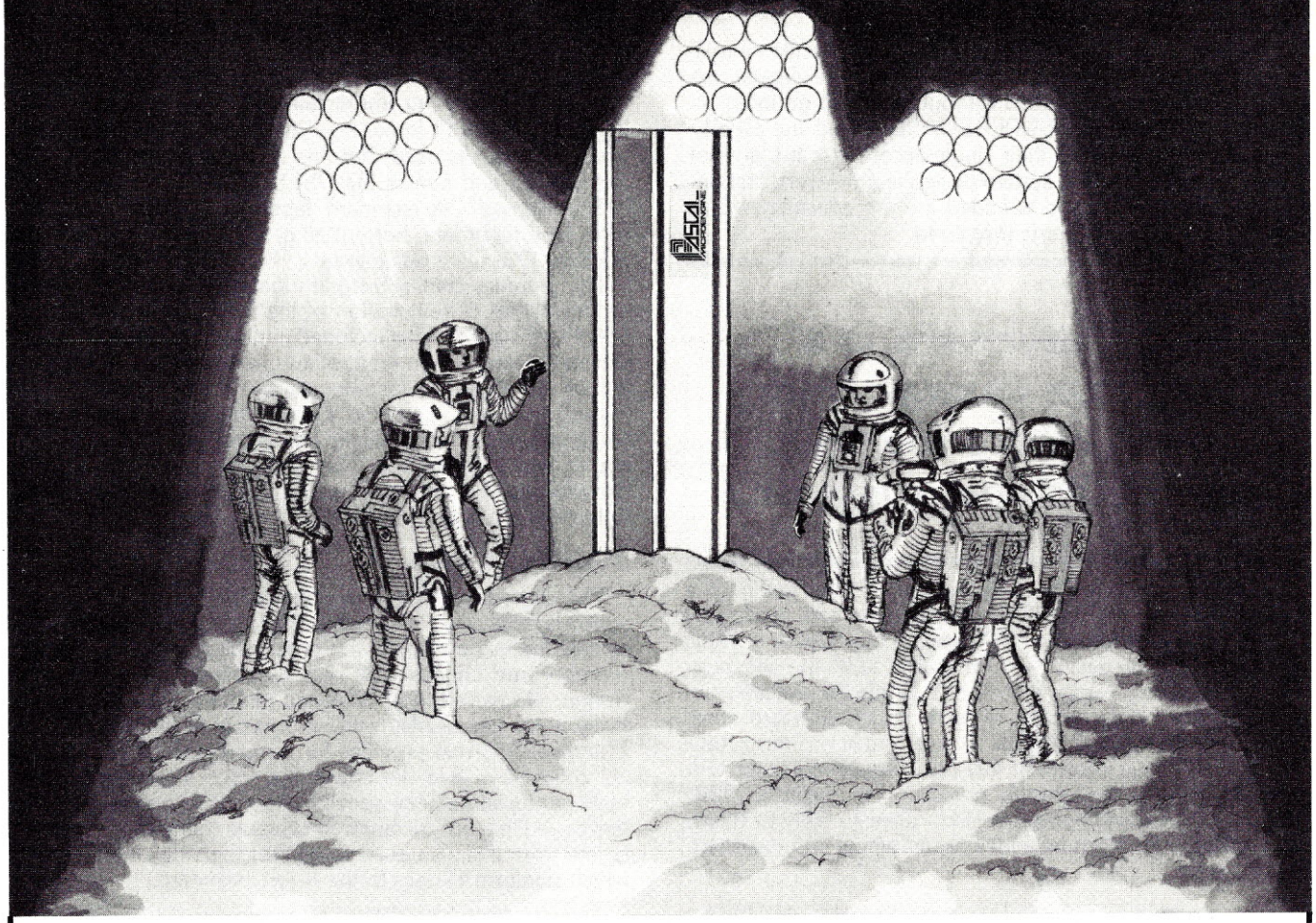
## A New Challenger Enters the Arena

By Roger H. Edelson, Hardware Editor

This month I will be reviewing the Ohio Scientific SUPERBOARD II, which becomes the CHALLENGER 1P when a power supply and cabinet are added. At $279 for the SUPERBOARD II, with 4K of RAM, built-in BASIC, a 6502 language monitor, and a full-fledged keyboard, this single board computer is one of the best buys going. The SUPERBOARD II in Photo 1 may also be obtained with a cabinet and power supply as the CHALLENGER 1P. Presently OSI has no plans to separately market the cabinet, although the power supply is available.

Both systems offer a 6502 based microprocessor running an 8K Microsoft BASIC stored in ROM. The ROM also contains a full machine code monitor and I/O utilities. The standard unit provides 4K of static RAM, which is expandable on the same board to 8K. Additionally, there is a direct access video display with 1K of static RAM, featuring upper and lower case as well as graphics and some special gaming characters. Depending on the design and set-up of the TV set used as a monitor, either 24x24 characters or 30x30 characters can be achieved. The unit sports a full 53-key computer style keyboard, providing user programmability.

# THE PASCAL ODYSSEY



## WHAT'S SO GREAT ABOUT PASCAL?

The Pascal programming language is a *masterpiece* of human creativity. Originated by Niklaus Wirth at the Swiss Institute of Technology in 1968, Pascal was intended to aid in the teaching of *programming* as a *systematic discipline,* where the fundamental concepts of algorithms could be clearly and naturally expressed.

Pascal makes it easy for the user to implement virtually *any* algorithm *reliably*, at an abstract, human level, rather than having to perform the usual mind-bending contortions required by most other programming languages. The elegance of the language has resulted in an unprecedented *wave of enthusiasm* among Earth's knowledgeable computer users, toward adopting Pascal as an *international standard programming language.*

## WHAT'S A MICROENGINE?

The **Pascal microengine™** is the world's first production implementation of Pascal in *hardware.* It executes UCSD Pascal intermediate code (P-code) *directly* as its *machine language*, thus being the first true "P-machine". The significance of this accomplishment should not be overlooked!

The desktop computer includes the 16-bit **Pascal microengine** processor, 64K bytes of RAM memory, complete DMA control functions, fully-integrated floppy disk controller (switch selectable for single or double density, mini or 8" floppy, and 1 to 4 disk drives), two RS-232 serial ports, two 8-bit parallel ports, floating point hardware, built-in power supply, self-test microdiagnostics, and an ASCII console.

The unit includes the complete UCSD Pascal operating system: Pascal compiler, BASIC compiler, file manager, screen-oriented text editor, program debugger, and a graphics package, all supported by thorough documentation. UCSD's version of Pascal incorporates random access file capability in addition to the sequential access capability of the original Pascal, and also includes x-y graphics.

For most business, educational, and personal applications, UCSD Pascal is a nearly ideal implementation tool. There are more users of UCSD Pascal today than users of all other versions combined. UCSD and Western Digital have agreed mutually to support this LSI implementation as the true UCSD standard.

## HOW MUCH?

**Khalsa Computer Systems** offers the **Pascal microengine™** alone at $2995, with peripherals available at extra cost. A typical *complete* system, included CRT, 80-column printer, and dual 8" floppy disk drives costs less than $7000.

For those of you who want to build the *brilliant machines* of the future, the **Pascal microengine™** chipset is also available separately for $195.

We offer significant quantity discounts on all the above items. Please write or call for more information.

**The Journey Begins At**

**KHALSA**

COMPUTER SYSTEMS INCORPORATED

500 South Lake Avenue, Pasadena (213)684-3311
Tuesday-Friday 12 noon to 8 pm, Saturday 12 noon to 6 pm
Closed Sunday and Monday

A 300 baud rate Kansas City standard audio cassette interface is also provided. In the same package an expander board which provides up to 24K of additional static RAM along with a dual mini-floppy interface, a port adapter for printer and modem, and an interface for the OSI 48 line bus can be added.

One of the weak points of this design is that while the system is expandable within the cabinet to a large degree, exterior goodies can't be added without having to go to an accessory unit. Also, the SUPERBOARD II and the CHALLENGER 1P, even with their single accessory card, are not bus oriented boards (the system design is, however). Not until the bus adapter board is added are the advantages of a card-to-card bus arrangement realized.

**The keyboard is a welcome change from some of the low end computational systems.**

Further, the bus is OSI's 48 line bus. It's not bad from a technical standpoint, but it doesn't have the card availability of the S-100 bus or some 6800 system bus structures. This is done mainly by design — OSI prefers to be the only supplier of accessory cards for their bus. While the available accessory board does greatly expand the single-board computer, it's not easy to upgrade to a full small business computer. OSI is quick to point this out, suggesting other OSI systems if this is the ultimate purpose. For about $2,000, however, two mini-floppies, a video display, 32K of RAM, and other goodies can be added to this single-board system.

## THE UNIT

The computer is contained on one rather large (14½" by 12" wide) circuit board. The system comes fully assembled and requires only a power supply and a video interface (either direct connection to a video monitor or an RF modulator). The unit reviewed differs from the picture in that the full 8K of RAM was present, as was the output connector and cables.

The system is based on the 6502 microprocessor. When supported by the resident Microsoft 8K BASIC, it is one of the fastest home computers around. The two versions use different keyboards; according to the OSI advertising agency, both production versions will be supplied with the keyboard shown in the SUPERBOARD II. This choice is unfortunate since the CHALLENGER 1P has by far the better choice of key tops with the full ASCII character set displayed.

One minor problem with the design concerns the RS-232C port which has been provided. RS-232 specifications require a negative power supply, usually −15 volts, which is not available from the standard OSI supplied power supply. The user must provide his own negative supply if RS-232 operaton is intended. Further, the serial port does not support a current-loop interface. However, this is only a minor annoyance. One other minor disadvantage of this serial port is that it runs at only 300 baud (to be compatible with Kansas City standard), a problem which is not a handicap when using the provided system video interface.

The video display including the direct access graphics is quite good and the 25 x 25 (or 24 x 24) character display is adequate. With the inclusion of the special symbols for games, etc., the graphics display is nicely detailed. The video only provides for a black-and-white display, with no intent to provide a color graphic capability in the future, according to OSI.

The keyboard is a welcome change from some of the low end computational systems, sporting a full ASCII complement and full-sized computer type keys. The keyboard is a polled design, which provides the capability for user defined keys and supports a novel repeat function. With the automatic repeat, any key will repeat if held down for longer than one-half second.

The system worked immediately with no problems. It was necessary to provide an interface to a TV set for the video. This was done by modifying an old transformer coupled set. The display came up immediately with good contrast and legibility — I don't know how much the display will suffer when RF input is used, but this depends on your interface and TV set, and not on the OSI SUPERBOARD II.

The Kansas City standard tape interface operates with most tape recorders, but not all of the taped programs provided by OSI were operational.

The graphics display program loaded easily and provided an interesting demonstration of the total graphics capability of the OSI system. This included a moving tank which could elevate its turret when firing at an overhead plane. One nice feature of the cassette loading interface is the visual display of the program as it is entered. During the load mode the data being inputted on the cassette port is routed both to memory and to the video storage. This technique allows the user to immediately spot any major errors in loading, or to see if the right program is being loaded.

## SYSTEM DESIGN

The computer utilizes a direct access 1K byte video display which is dedicated to the video display. To make changes or update the video display, the processor gains control of the memory and changes the data as desired. This dedicated design, along with well designed circuitry, provides a relatively noise free display without breakup or interfering lines. The display format provides for a maximum of 32 rows by 32 columns of 8x8 dot characters. Each stored byte in the memory locations may specify one of 256 discrete characters stored in a proprietary OSI character generator. The processor crystal is also used to control the video sync signals which conform closely to the NTSC standard.

The effective video data transfer rate out of this interface is approximatly 4MHz, compatible with conventional TV receivers and standard home video equipment. The video display is designed with no provision for vertical or horizontal guard bands, which are normally needed to correct for the standard over-scan built into home TV equipment. For this reason, the normal television receiver will only display a 24x24 display. All OSI software is designed to select this display size in the video/graphics display. If the receiver can be reconfigured to provide no over-scan (by adjusting the voltage or the deflection circuitry) the entire 32x32 character matrix may be displayed. The display was quite adequate both for normal computation and graphics; the characters were legible and quite readable.

Once the power supply is plugged in and the TV set turned on, the screen will fill with a very random array of characters. The user then presses the break key; and, if the shift lock switch is locked down (to set the system to the BASIC mode), the screen will prompt with a "C/W/M ?". When the key "C" is pressed the screen requests memory size and when this is answered it will request terminal width. CR's may be substituted for actual numbers and the computer will default to the full memory installed and 24x24 display capability. At this point the computer is in BASIC and programming can begin. The I/O routines and the cassette LOAD and SAVE routines are all stored in ROM as is the 8K Microsoft BASIC.

The SUPERBOARD II and its fully dressed companion the CHALLENGER 1P series incorporate all the fundamental necessities of a personal computer at a very attractive price. With the expansion capabilities provided, this series becomes a very formidable competitor in the home computer arena.□

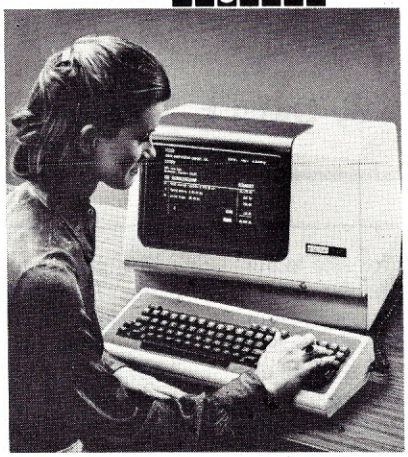
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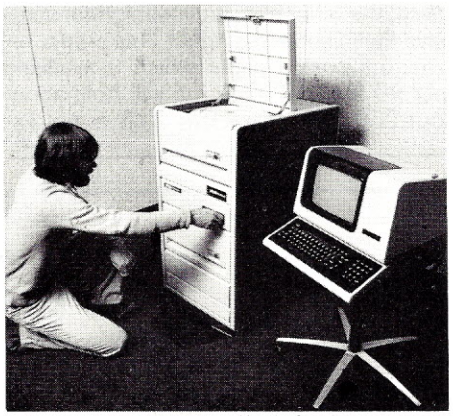
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# High Performance, Low Cost New Printer

By Owen F. Thomas

An electric discharge printer is being offered for sale to the OEM market for $257 assembled. This could be the output device that the hobby and small systems users have been wishing for. The printer will produce 44 characters in half a second in a 5x7 dot matrix format on paper 6 cm. wide; and it will do that continuously. Software control will produce larger characters for emphasis and will allow graphics to be printed. The low cost is achieved by a simple printing mechanism, limited number of components on the interface board, and software to provide all of the logic control to the printer.

There is no distributor to the hobby market at the present, but the manufacturer will deliver single units from the factory. You must write to Electronic Products Associates, Inc., 1157 Vega Street, San Diego, CA 92110 if you want one at once. Perhaps someone will advertise soon as a distributor to the hobby and small system users.

The printer mechanism comes from a distributor in Germany. Those who wish to try assembling their own system can contact Datamega KA, 8011 Putzbrunn, Munich, Germany. Their catalog lists the printer mechanism only as MP 310/21L for 160 German Marks. I do not know of a source for single units in this country, but anyone wishing to build their own interface from information in this article can try offering the equivalent of 160 German Marks to EPA. A cash offer would probably not be refused. Printed circuit board layout, or wire wrapping, must be done carefully in a homebrew system to keep noise out of the low level signal from a magnetic pickup; the other circuitry is straightforward.

All good things have their problems, right? This printer requires a special aluminum coated paper which is available from EPA at 95¢ per 90 foot roll. One roll will hold about 6,000 lines, or about 250,000 characters. This is not ex-

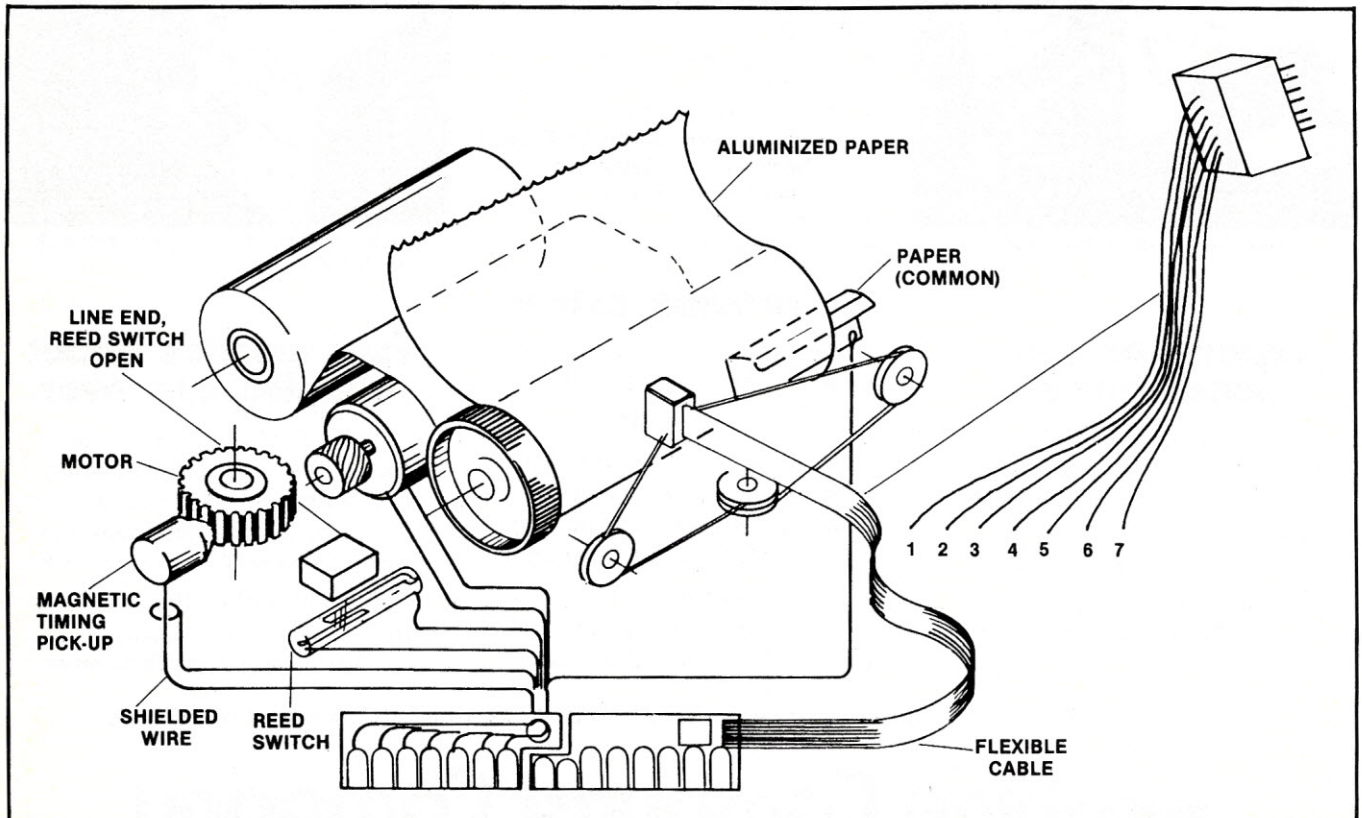



**Figure 1. Megatron MP310 Printer Mechanism.**

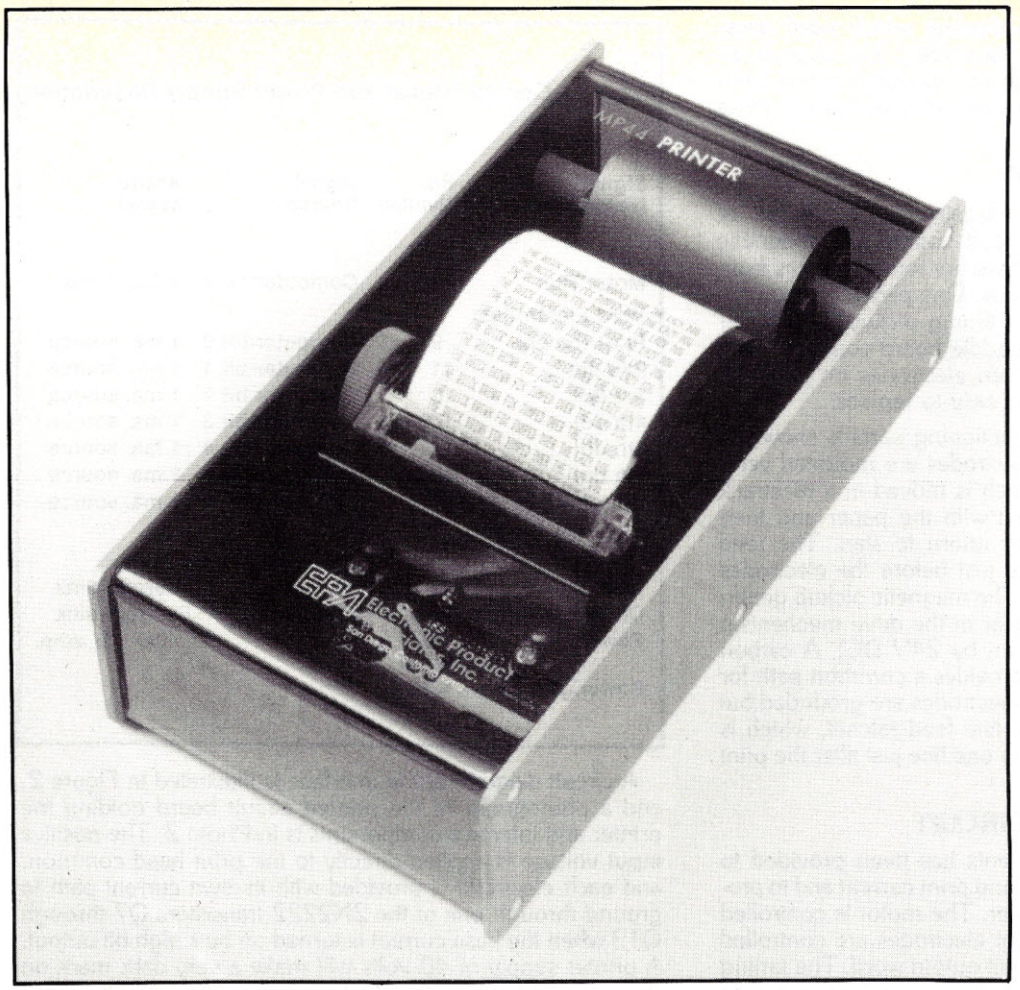



**PHOTO 1**

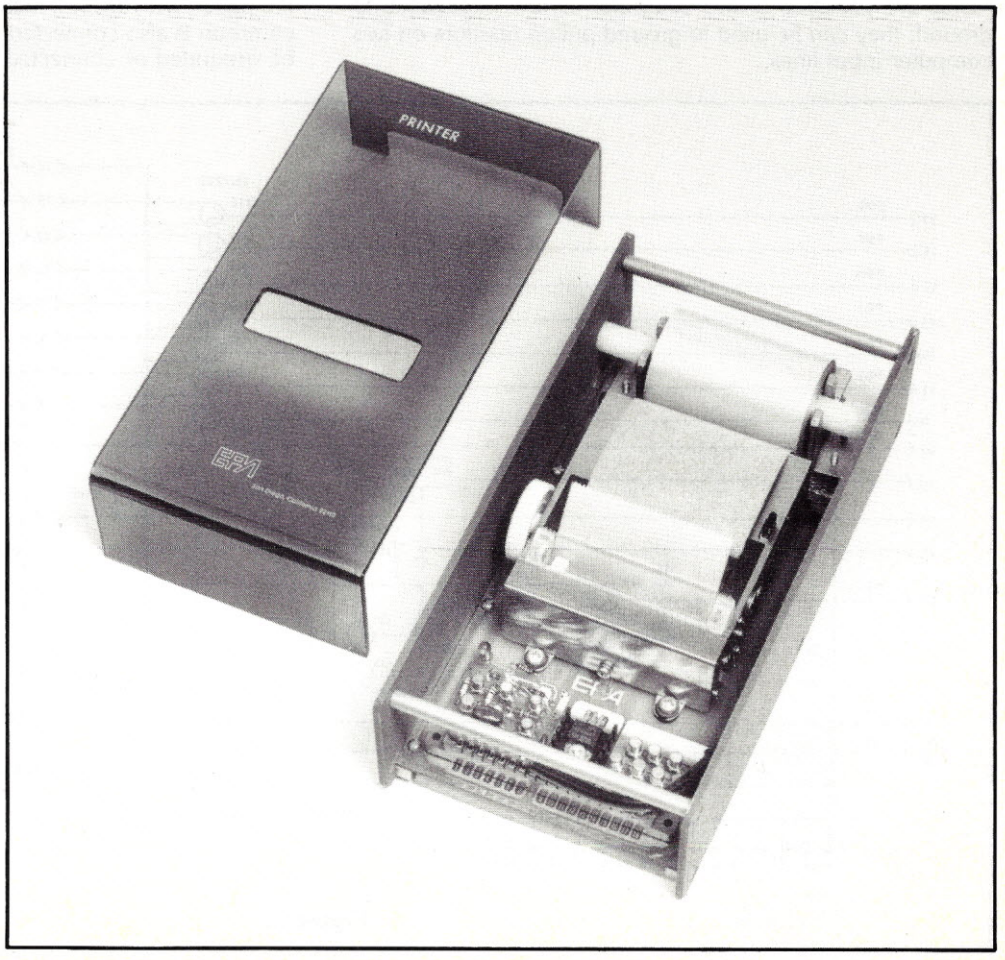



**PHOTO 2**

pensive for systems with video displays which need occasional permanent copies from the screen. The copy is archival, it never fades, and copy machines will work well from the original. So there is some bad news and good news about paper!

## HARDWARE DESCRIPTION

The print mechanism from Megatron is a box full of pulleys, cables, gears, motor, reed switch, and magnetic pickup coil for timing pulses. There are fourteen wires from the box to two small paddle boards. One paddle board connects to the motor, reed switch, timing pickup, and paper common electrode. The other paddle board connects via a flexible printed circuit to the seven electrodes on the print head. This makes the print head easy to replace.

A conceptual layout of the functioning parts is shown in Figure 1. The seven printing electrodes are mounted vertically in a small plastic block which is moved in a racetrack path from left to right in contact with the paper and then moved away from the paper for return to start. The reed switch is open for a short space just before the electrodes touch the left edge of the paper. The magnetic pickup generates a periodic voltage from a gear in the drive mechanism while the motor is turning (driven by 24V DC). A carbon roller in contact with the paper provides a common path for the print current when the print electrodes are grounded but limits the current. An automatic line feed ratchet, which is not illustrated, advances the paper one line just after the print head leaves the paper.

## COMPUTER INTERFACE CIRCUIT

A minimum of extra components has been provided to allow computer control of motor and print current and to provide timing marks to the computer. The motor is controlled with one output bit, and the print electrodes are controlled with the other seven bits of an 8-bit output word. The timing marks are provided to the computer as low impedance to ground; they can be used to ground pullup resistors on two computer input lines.

**Table 1. Control Signal and Power Supply Description**

| Signal Description | Pin Number | Signal Source | Active Signal |
|---|---|---|---|
| Motor Run | 23 | Computer bit 7 | + 5v., 1 ma. |
| Print Electrodes: | | | |
| Print top dot | 9 | Computer bit 0 | 1 ma. source |
| 2nd dot | 11 | Computer bit 1 | 1 ma. source |
| 3rd dot | 13 | Computer bit 2 | 1 ma. source |
| 4th dot | 15 | Computer bit 3 | 1 ma. source |
| 5th dot | 17 | Computer bit 4 | 1 ma. source |
| 6th dot | 19 | Computer bit 5 | 1 ma. source |
| Bottom dot | 21 | Computer bit 6 | 1 ma. source |
| Line end | 27 | Printer | current sink |
| Character timing | 25 | Printer | current sink |
| Power | 43,44, 45,46 | | 40v. ¼ amp. |
| Power ground | 1,2,3,4 | | |

A circuit diagram of the interface is illustrated in Figure 2, and a photograph of the printed circuit board holding the printer and interface components is in Photo 2. The positive input voltage is applied directly to the print head common, and each electrode is provided with its own current path to ground through one of the 2N2222 transistors Q7 through Q13 when the base current is turned on by a high bit output. A printer supply of 40 volts will make a very dark mark on the paper; 30 volts will make an acceptable mark. The paper common is also connected to the printer case, so it must not be grounded or connected to metallic parts of the system.

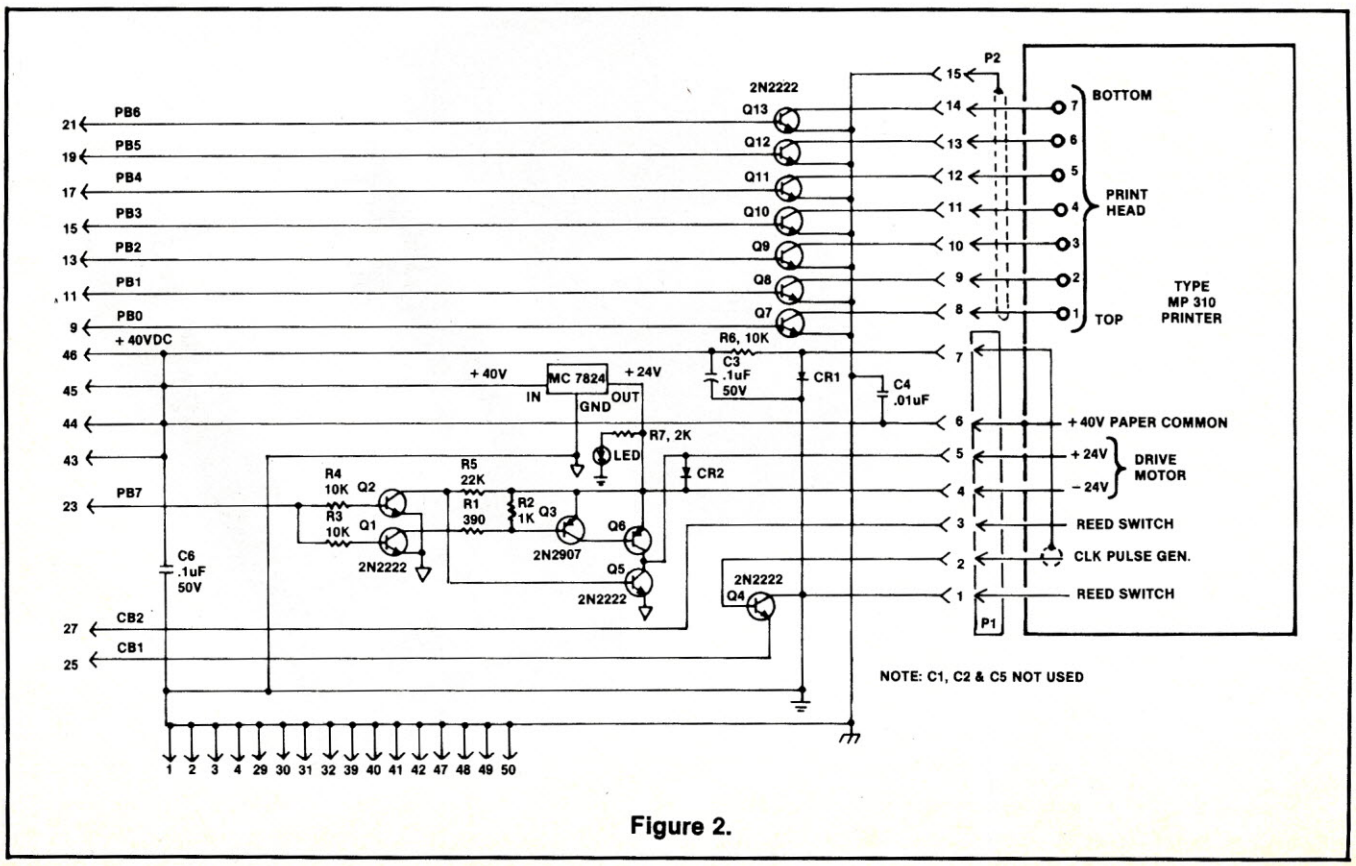



**Figure 2.**

The other computer output bit drives the five transistors Q2 through Q6. This complicated circuit is required to provide dynamic braking to the motor when the output bit is high as well as to pass current to the motor when the bit is low. A voltage regulator is provided to produce the specified 24-volt motor drive regardless of what printing voltage is used.

The reed switch is grounded on one side, and the other side goes direct to the pullup resistor on the computer input line. When the reed switch opens, the bit goes high, and the computer can stop the motor before the next line begins.

The periodic timing marks are only about 0.6 volts peak to peak and require special conditioning for computer input. The pickup coil shield is biased up from ground by one diode drop across CR2, making the base of Q1 the same potential as the emitter when the motor is off. When the motor runs, it will cause the pickup coil to turn Q1 on for a part of each timing period and therefore provide a low impedance to ground for a pullup resistor on the computer input line. This will cause the collector of Q1 to be at a low voltage during part of each timing period to generate a timing signal for use by the computer in determining when to activate the print electrode bits.

No more interface components are required to allow the computer software to print a 44-column line as the printer head crosses the paper in half a second. The subroutine which controls this interface will be explained in detail in the context of a software package to print a line of characters which are input from an ASCII keyboard. The printer control software is a single subroutine called LINPTR described under software.

## SOFTWARE DESCRIPTION

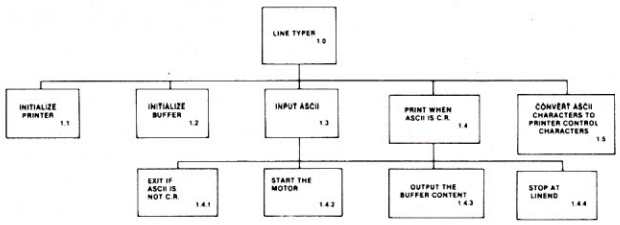



**Figure 3. Table of Software Organization.**

This description uses a set of visual aids to enhance the introduction of data and control concepts before presenting program listings.* Figure 3 shows the organization of software modules to accomplish a line typer task. Each module of the figure has a key number in the lower right corner of its box as a key to the following descriptions.

### Overview

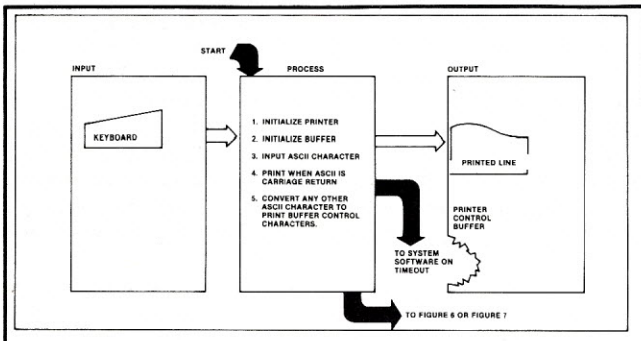
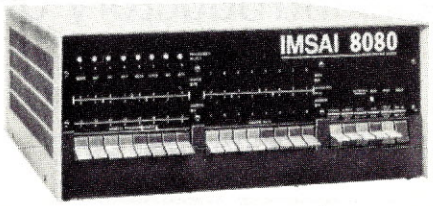



**Figure 4. "Line Typer"**

The overview of all software is illustrated in Figure 4. This figure is typical of all the module descriptions; it is divided into three boxes, one to show data input to the module, one to show the process performed by the module, and one to

*The technique is explained in "Systems Design and Documentation" by Harry Katzan, Jr.


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show the data output by the module. Open arrows show data movement from input box through the process box to the output box. Solid arrows show where the process starts and what process comes next.

The overview diagram shows general features rather than complete detail. This process accepts input from a keyboard, has five steps in the process, and produces a printed line when the ASCII character from the keyboard is a carriage return. Other ASCII characters are converted to printer control words and placed in a control word buffer. When the process is finished, control will be returned to step 2 or 3 of the same process. This module is therefore a closed loop; it will continue to accept keyboard input and pass it to the printer until it is interrupted by a reset or a timeout from a late timing mark. Each step of this process will be expanded in the following figures and descriptions. After all the modules are understood, it will be easy to use them as they are or to adapt the coding for other applications.

### Initialization

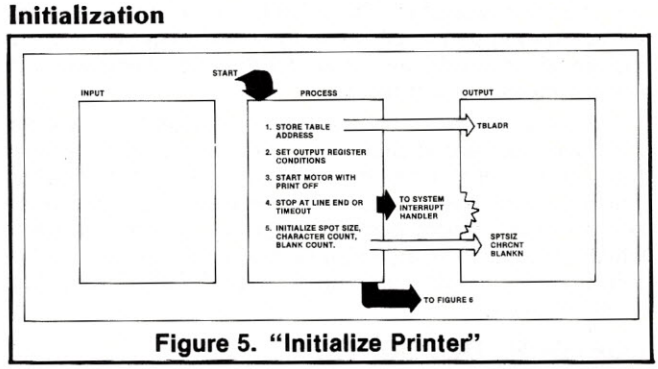



**Figure 5. "Initialize Printer"**

Printer initialization details are presented in Figure 5. Initialization is performed by a single subroutine called INITPR which is written to be contained in a read-only memory at any location which may be convenient to a system designer who wishes to use the printer. The read-only memory can also contain a table of printer control words; the address of the table is determined by the program and stored in random access read/write memory where it will be referred to by the name TBLADR. The peripheral interface adapter, or an 8-bit output port, is set for all bits to be outputs. The motor is started and allowed to run to the start of a new line. At line end it should set a data bit or generate an interrupt; in the event that this does not occur in a reasonable time, there will be a software interrupt generated. This interrupt can be interpreted by the system operator or system software to start necessary corrective action.

If the printer reaches line end in time, the printer is ready to operate, so default values will be stored in three locations to control the format of the printed line. A line generated by these values will have 44 characters separated by 2/5ths character spacing. The number 1 to control spot size, and therefore character size, is stored and will be referred to by the name SPTSIZ. The number 44 to control number of characters is stored and will be referred to by the name CHRCNT. The number 2 to control space between characters is stored and will be referred to by the name BLANKN. These default values could be modified by other software if desired as long as the product CHRCNT (5+BLANKN) is less than 310.

Line typer software control starts with printer initialization; control passes to buffer initialization when the printer responds or goes to system software when the printer does not respond.

### Buffer Initialization

Printer control characters are stored in a buffer in read/write memory until the printer is commanded to print a line. This buffer is initialized by the software illustrated in Figure 6. The software is a single subroutine called CAINIT, and it can be in read-only memory when the system designer

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has established the buffer location and size. The beginning address of the buffer is stored and will be known by the name BUFSTR. The beginning address is also stored in the location called BUFPTR where it will be used as a pointer for the next empty location in the buffer. The Buffer end address is computed and stored in the location called BUFEND. A control word is stored in all buffer locations to cause the motor to run without printing unless the word is changed when a character is input from the keyboard. This has the effect of causing blank lines to be printed when a carriage return is the first character from the keyboard.

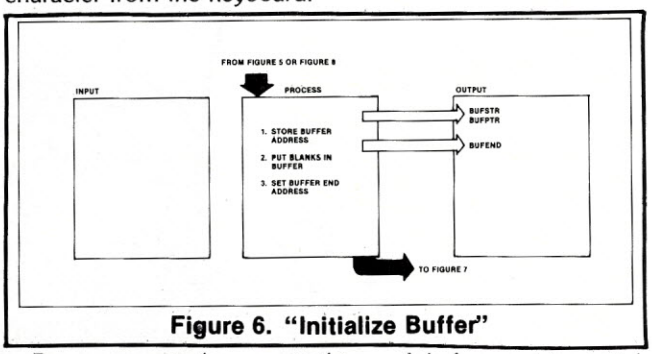



**Figure 6. "Initialize Buffer"**

Program control comes to this module from printer initialization or from printing a line. Control goes to input an ASCII character from the keyboard.

**Input ASCII**

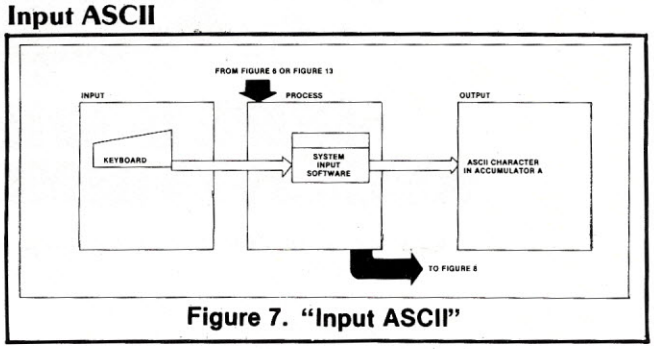



**Figure 7. "Input ASCII"**

The keyboard input is illustrated in Figure 7. All the software for ASCII input from a serial keyboard is provided in the MIKBUG routine at location $E1AC. When program control is passed to that routine and a key is pressed on a serial ASCII keyboard, the ASCII character will be returned in accumulator A. Another system input routine must be established in systems not using the 6800 microcomputer. Program control comes to this module from initializing the buffer or after converting an ASCII character to printer buffer control characters. Control always goes next to print when the ASCII character is a Carriage Return.

**Print When . . .**

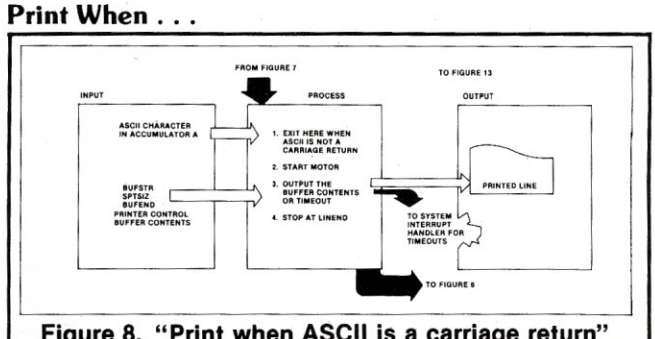



**Figure 8. "Print when ASCII is a carriage return"**

The process to print when the ASCII character is a carriage return is illustrated in Figure 8. Step one tests the character and exits for all characters except the carriage return. This test is in read/write memory; all the rest is the LINPTR subroutine and can be in the read-only memory where it can be used as desired by a system designer to print the entire contents of a buffer full of control characters.



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The printing process starts the motor and outputs the entire buffer contents under timing controlled by a data input line (or interrupt line) from the timing gear. The motor is then allowed to continue running until the reed switch closes to signal the end of line. If any of the timing signals fail to occur within a reasonable time, an exit will be made to system software to signal a failure. The system operator or system software must then determine what corrective action to take. This timeout facility is provided to prevent the printer program from entering an endless loop in read-only memory — an event which is difficult to diagnose.

This module uses the ASCII character in accumulator A, the buffer start address at BUFSTR, the buffer and address at BUFEND, the spot size control at SPTSIZ, and all the contents of the printer control buffer. The buffer will not have any words to cause printing until control has passed through the module described in Converting to ASCII Characters. A printed line will be output by this module when there are appropriate control characters in the buffer and the input character is a carriage return.

Control comes to this module when an ASCII character has been input. Control goes to convert the character to printer control words when not a carriage return; it goes to the system software when there is a late input from the timing sensor; and it goes to initialize the buffer when a line has been printed successfully.

This module contains the complete interface control software (more detailed description follows in the next four sections of Software Description).

### Exit If ASCII Is Not Carriage Return

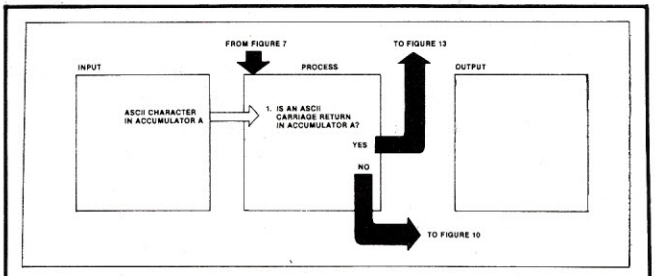



**Figure 9. "Exit if ASCII is not a carriage return"**

This part of the line typer software is illustrated in Figure 9. The printer control is started when the ASCII character is a carriage return or control goes to convert other characters to printer control words in the buffer.

### Start the Motor

This part of the software is illustrated in Figure 10. The coding is part of the LINPTR subroutine which can be in read-only memory.

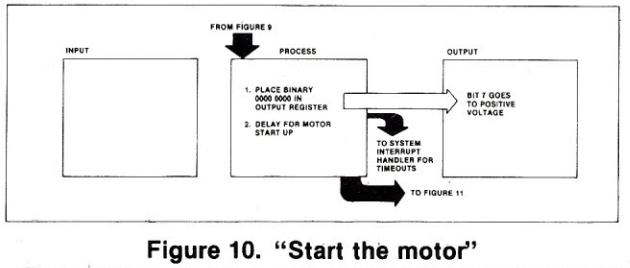



**Figure 10. "Start the motor"**

A binary word 0000 0000 is placed in the output register. This has the effect of moving bit seven to a low voltage in the interface to cause the motor to start. A time delay is necessary to allow the print head to be placed in contact with the paper. The delay is accomplished by waiting until the reed switch closes before proceeding to the next task. An exit is made to the system interrupt handler if the reed switch does not close.


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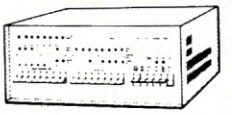
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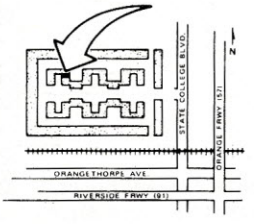
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### Output the Buffer Contents

This part of the software controls the print electrode current. The illustration in Figure 11 shows the detail of operation.

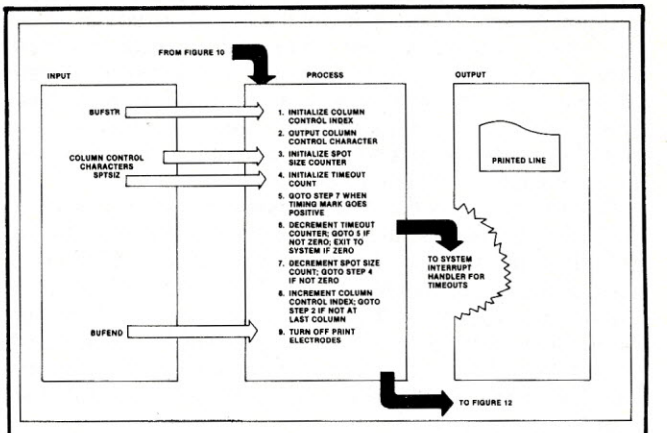



**Figure 11. "Output the buffer contents or timeout"**

There are three loops in this module. The outer loop starts the column control character index at the start of the buffer as stored in BUFSTR. This loop ends at step 8 where a test is made to see if all column control characters have been output up to the address stored at BUFEND. When all have been output, the print electrodes are turned off and control goes to the next module.

The second loop controls spot size, starting at step 3 and ending at step 7. This loop counts timing marks as specified by SPTSIZ before allowing the column control character to be incremented.

The third loop is at steps 4, 5, and 6, where the timeout counter is decremented while waiting for a timing mark. If the timeout counter reaches zero before a timing mark is received, there will be an exit to the system software.

### Stop At Line End

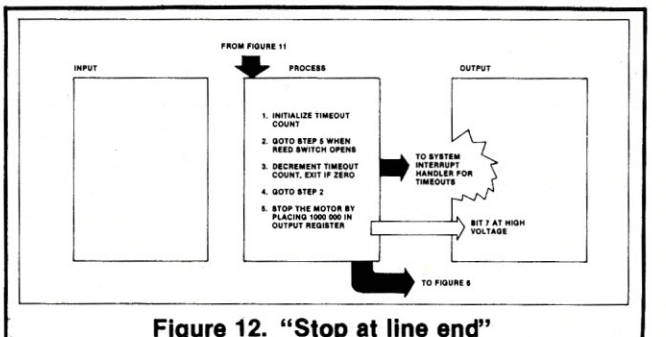


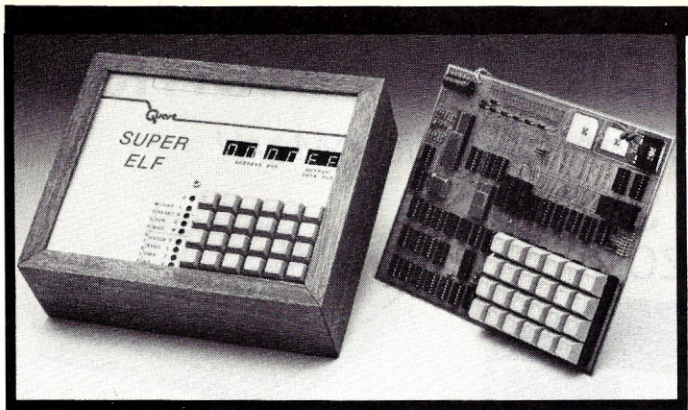

**Figure 12. "Stop at line end"**

This module is illustrated in Figure 12. It delays until the reed switch opens at line end and then puts a binary 1000 0000 in the output register to turn off the motor and print electrodes. A timeout loop is included to exit to system software in case the reed relay does not open within a reasonable time.

### Convert ASCII Characters

The module to convert ASCII characters to printer control words is illustrated in Figure 13. This is a single subroutine called CACTPB in read/write memory. In code for the 6800 computer, the stack pointer is saved in the first step. It is used in transferring words from the conversion table to the print control buffer and is restored at step six to provide correct return to the control program.

Next, the ASCII character is tested to determine if it is in the printable set; nonprintable characters will be ignored. A printable ASCII character will be converted to five words for control of the print electrodes and moved to the buffer location indicated by the buffer storage pointer. Inter-character blank columns will be provided in the buffer by incrementing the buffer




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| LM340K-5 | 1.35 | CD4082 | .21 | 8085 | 27.00 |
| LM340K-8 | 1.35 | CD4116 | .47 | Z80A | 19.75 |
| LM340K-12 | 1.35 | CD4490 | 5.50 | 8212 | 2.90 |
| LM340K-15 | 1.35 | CD4507 | 1.00 | 8214 | 8.00 |
| LM340K-24 | 1.35 | CD4508 | 4.25 | 8216 | 2.90 |
| LM340T-5 | 1.25 | CD4510 | 1.02 | 8224 | 2.90 |
| LM340T-8 | 1.25 | CD4511 | .94 | 8228 | 5.35 |
| LM340T-12 | 1.25 | CD4515 | 2.52 | 8251 | 8.50 |
| LM340T-15 | 1.25 | CD4516 | 1.10 | 8253 | 10.00 |
| LM340T-18 | 1.25 | CD4518 | 1.02 | 8255 | 9.25 |
| LM340T-24 | 1.25 | CD4520 | 1.02 | 8257 | 19.50 |
| LM343H | 4.50 | CD4527 | 1.51 | 8259 | 19.50 |
| LM350 | 7.50 | CD4528 | .79 | CDP1802CD | 19.95 |
| | | | | CDP1802D | 25.00 |
| | | | | CDP1861 | 12.95 |
| | | | | 6820 | 9.95 |
| | | | | 6850 | 12.95 |
| | | | | 6502 | 12.50 |

**IC SOCKETS**

| Solder Tin | | Low Profile | |
|---|---|---|---|
| PIN | 1 UP | PIN | 1UP |
| 8 | .15 | 22 | .30 |
| 14 | .18 | 24 | .35 |
| 16 | .20 | 28 | .42 |
| 18 | .27 | 36 | .58 |
| 20 | .29 | 40 | .57 |

3 level wire wrap gold.
14 pin .25
2 level 14 pin ww .20

**WIRE WRAP LEVEL 3**

| PIN | | PIN | |
|---|---|---|---|
| 14 | .25 | 24 | .86 |
| 16 | .33 | 28 | 1.00 |
| 18 | .57 | 40 | 1.23 |

**UART/FIFO**

| | |
|---|---|
| AY5-1013 | 5.50 |
| AY5-1014 | 7.50 |
| 3341 | 6.95 |

**PROM**

| | |
|---|---|
| 1702A | 3.95 |
| N82S23 | 2.95 |
| N82S123 | 3.50 |
| N82S126 | 3.75 |
| N82S129 | 3.75 |
| N82S131 | 3.75 |
| N82S136 | 8.75 |
| N82S137 | 8.75 |
| 2708 | 10.50 |
| DM8577 | 2.90 |
| 8223 | 2.90 |
| 2716T1 | 29.50 |
| 2716 Intel | 48.00 |

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| 2 MHz | 4.50 |
| 4 MHz | 4.25 |
| 5 MHz | 4.25 |
| 10 MHz | 4.25 |
| 18 MHz | 3.90 |
| 20 MHz | 3.90 |
| 32 MHz | 3.90 |
| 32768 MHz | 4.00 |
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| 3.5795 MHz | 1.20 |
| 2.0100 MHz | 1.95 |
| 2.097152 MHz | 4.50 |
| 2.4576 MHz | 4.50 |
| 3.2768 MHz | 4.50 |
| 5.0688 MHz | 4.50 |
| 5.185 MHz | 4.50 |
| 5.7143 MHz | 4.50 |
| 6.5536 MHz | 4.50 |
| 14.31818 MHz | 4.25 |
| 18.432 MHz | 4.50 |
| 22.1184 MHz | 4.50 |

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|---|---|
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| 100 pin edge WW | 5.25 |

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| AY5-3600 | 13.50 |
| 74C922 | 5.50 |
| 74C923 | 5.50 |
| HD0165-5 | 6.95 |

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| | 1 | 10 |
|---|---|---|
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| Black | .55 | .47 |

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|---|---|
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| 2N2222A | .18 |
| 2N2369 | .30 |
| 2N2904A | .20 |
| 2N2907A | .25 |
| 2N3053 | .40 |
| 2N3638 | .25 |
| 2N3643 | .25 |
| 2N3904 | .18 |
| 2N3906 | .18 |
| 2N3055 | .69 |
| 2N4400 | .25 |
| 2N4401 | .75 |
| 2N4402 | .20 |
| TIP31 | .60 |
| TIP33A | 1.00 |

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|---|---|
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| DB25P | 2.95 |
| DB25S | 3.95 |
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| RS232 Complete Set | 6.50 |
| DE9P | 1.50 |
| DE9S | 1.95 |
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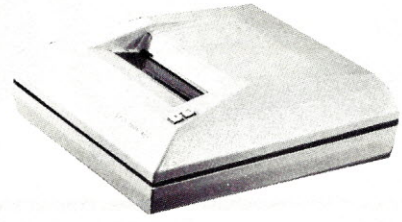
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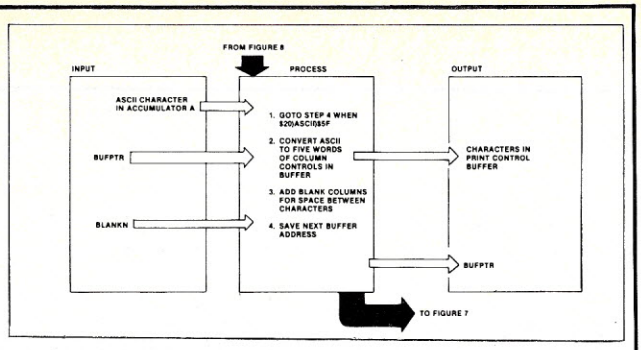



**Figure 13. "Convert ASCII character to printer control words"**

storage pointer an additional number, as indicated by BLANKN, before storing the pointer for use the next time.

This routine uses the ASCII character in accumulator A, the table of conversion from ASCII to column control words, the buffer storage pointer at BUFPTR, and the spacing control at BLANKN. It updates the buffer control pointer, outputs control words to the buffer, and leaves a value called TBLCHR which points to the character moved from the conversion table.

Control comes to this routine from "print when ASCII is a carriage return" and goes to "input ASCII."

## COMPUTER SOURCE CODE FOR THE 6800

Program listings are provided for 6800 computers in Listing 1. The comments consist of references to appropriate sections of the software description for detail of the functions being performed. A lookup table named TABLE provides CACTPB, the bit patterns for conversion of ASCII code to seven bit column control words. The Line Typer starts at address $3A5B; an additional entry point at $3A70 will allow entries via the "G" command to the MIKBUG monitor to stop the motor in case of a software interrupt and to restart at the proper address again by another "G" command.

The memory map for this code after assembly is provided in Table 2.

**Table 2. Memory Map for 6800**

| | |
|---|---|
| 3FB4 | top of 44 character buffer |
| 3E80 | beginning of buffer |
| | |
| 3DFF | top of table |
| 3CC0 | start of table |
| 3C7C | LINPTR |
| 3C4F | INITPR |
| 3C2E | BEQOTO |
| 3C0D | BNEOTO |
| 3C06 | XDELAY |
| 3C00 | DELAY |
| | |
| 3B81 | top of auxiliary routines |
| 3B70 | GSTART |
| 3B5B | TESTPR |
| 3B1F | CACTPB |
| 3B00 | CAINIT |

## SUMMARY

The printer is extremely flexible and works well in just about any system configuration. Although only software for the 6800 was shown, the techniques discussed and demonstrated work with 8080 type machines.□

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## Program Listing

```
00001                    NAM   TABLE
00002                    OPT   MEM
00003 3CC0               ORG   $3CC0
00004 3CC0 0000          FDB   0
00005 3CC2 0000          FDB   0
00006 3CC4 00            FCB   0          * SPACE
00007 3CC5 0000          FDB   0
00008 3CC7 4F00          FDB   $4F00
00009 3CC9 00            FCB   0          * !
00010 3CCA 0007          FDB   7
00011 3CCC 0007          FDB   7
00012 3CCE 00            FCB   0          * "
00013 3CCF 147F          FDB   $147F
00014 3CD1 147F          FDB   $147F
00015 3CD3 14            FCB   $14        * #
00016 3CD4 242A          FDB   $242A
00017 3CD6 7F2A          FDB   $7F2A
00018 3CD8 12            FCB   $12        * $
00019 3CD9 2313          FDB   $2313
00020 3CDB 0864          FDB   $864
00021 3CDD 62            FCB   $62        * %
00022 3CDE 304E          FDB   $304E
00023 3CE0 5926          FDB   $5926
00024 3CE2 50            FCB   $50        * &
00025 3CE3 0004          FDB   4
00026 3CE5 0201          FDB   $201
00027 3CE7 00            FCB   0          * '
00028 3CE8 001C          FDB   $1C
00029 3CEA 2241          FDB   $2241
00030 3CEC 00            FCB   0          * (
00031 3CED 0041          FDB   $41
00032 3CEF 221C          FDB   $221C
00033 3CF1 00            FCB   0          * )
00034 3CF2 1408          FDB   $1408
00035 3CF4 3E08          FDB   $3E08
00036 3CF6 14            FCB   $14        * *
00037 3CF7 0808          FDB   $808
00038 3CF9 3E08          FDB   $3E08
00039 3CFB 08            FCB   8          * +
00040 3CFC 0040          FDB   $40
00041 3CFE 3000          FDB   $3000
00042 3D00 00            FCB   0          * ,
00043 3D01 0808          FDB   $808
00044 3D03 0808          FDB   $808
00045 3D05 08            FCB   8          * -
00046 3D06 0060          FDB   $60
00097 3D5B 0201          FDB   $201
00098 3D5D 7109          FDB   $7109
00099 3D5F 06            FCB   6          * ?
00100 3D60 3E41          FDB   $3E41
00101 3D62 5D55          FDB   $5D55
00102 3D64 5E            FCB   $5E        * @
00103 3D65 7E09          FDB   $7E09
00104 3D67 0909          FDB   $909
00105 3D69 7E            FCB   $7E        * A
00106 3D6A 7F49          FDB   $7F49
00107 3D6C 4949          FDB   $4949
00108 3D6E 36            FCB   $36        * B
00109 3D6F 3E41          FDB   $3E41
00110 3D71 4141          FDB   $4141
00111 3D73 22            FCB   $22        * C
00112 3D74 7F41          FDB   $7F41
00113 3D76 4122          FDB   $4122
00114 3D78 1C            FCB   $1C        * D
00115 3D79 7F49          FDB   $7F49
00116 3D7B 4949          FDB   $4949
00117 3D7D 41            FCB   $41        * E
00118 3D7E 7F09          FDB   $7F09
00119 3D80 0909          FDB   $909
00120 3D82 01            FCB   1          * F
00121 3D83 3E41          FDB   $3E41
00122 3D85 4149          FDB   $4149
00123 3D87 79            FCB   $79        * G
00124 3D88 7F08          FDB   $7F08
00125 3D8A 0808          FDB   $808
00126 3D8C 7F            FCB   $7F        * H
00127 3D8D 0041          FDB   $41
00128 3D8F 7F41          FDB   $7F41
00129 3D91 00            FCB   0          * I
00130 3D92 2040          FDB   $2040
00131 3D94 413F          FDB   $413F
00132 3D96 01            FCB   1          * J
00133 3D97 7F08          FDB   $7F08
00134 3D99 1422          FDB   $1422
00135 3D9B 41            FCB   $41        * K
00136 3D9C 7F40          FDB   $7F40
00137 3D9E 4040          FDB   $4040
00138 3DA0 40            FCB   $40        * L
00139 3DA1 7F02          FDB   $7F02
00140 3DA3 0402          FDB   $402
00141 3DA5 7F            FCB   $7F        * M
00142 3DA6 7F04          FDB   $7F04
00143 3DA8 0810          FDB   $810
00144 3DAA 7F            FCB   $7F        * N
00145 3DAB 3E41          FDB   $3E41
00146 3DAD 4141          FDB   $4141
```

```
00047 3D08 6000          FDB    $6000
00048 3D0A 00            FCB    0          * .
00049 3D0B 2010          FDB    $2010
00050 3D0D 0804          FDB    $804
00051 3D0F 02            FCB    2          * /
00052 3D10 3E51          FDB    $3E51
00053 3D12 4945          FDB    $4945
00054 3D14 3E            FCB    $3E        * 0
00055 3D15 0042          FDB    $42
00056 3D17 7F40          FDB    $7F40
00057 3D19 00            FCB    0          * 1
00058 3D1A 4261          FDB    $4261
00059 3D1C 5149          FDB    $5149
00060 3D1E 46            FCB    $46        * 2
00061 3D1F 2141          FDB    $2141
00062 3D21 454B          FDB    $454B
00063 3D23 31            FCB    $31        * 3
00064 3D24 1814          FDB    $1814
00065 3D26 127F          FDB    $127F
00066 3D28 10            FCB    $10        * 4
00067 3D29 2745          FDB    $2745
00068 3D2B 4545          FDB    $4545
00069 3D2D 39            FCB    $39        * 5
00070 3D2E 3C4A          FDB    $3C4A
00071 3D30 4949          FDB    $4949
00072 3D32 30            FCB    $30        * 6
00073 3D33 0171          FDB    $171
00074 3D35 0905          FDB    $905
00075 3D37 03            FCB    $3         * 7
00076 3D38 3649          FDB    $3649
00077 3D3A 4949          FDB    $4949
00078 3D3C 36            FCB    $36        * 8
00079 3D3D 0649          FDB    $649
00080 3D3F 4929          FDB    $4929
00081 3D41 1E            FCB    $1E        * 9
00082 3D42 0063          FDB    $63
00083 3D44 6300          FDB    $6300
00084 3D46 00            FCB    0          * :
00085 3D47 0000          FDB    0
00086 3D49 4033          FDB    $4033
00087 3D4B 00            FCB    0          * ;
00088 3D4C 0814          FDB    $814
00089 3D4E 2241          FDB    $2241
00090 3D50 00            FCB    0          * <
00091 3D51 1414          FDB    $1414
00092 3D53 1414          FDB    $1414
00093 3D55 14            FCB    $14        * =
00094 3D56 0041          FDB    $41
00095 3D58 2214          FDB    $2214
00096 3D5A 08            FCB    8          * >
```

```
00147 3DAF 3E            FCB    $3E        * O
00148 3DB0 7F09          FDB    $7F09
00149 3DB2 0909          FDB    $909
00150 3DB4 06            FCB    6          * P
00151 3DB5 3E41          FDB    $3E41
00152 3DB7 5121          FDB    $5121
00153 3DB9 5E            FCB    $5E        * Q
00154 3DBA 7F09          FDB    $7F09
00155 3DBC 1929          FDB    $1929
00156 3DBE 46            FCB    $46        * R
00157 3DBF 4649          FDB    $4649
00158 3DC1 4949          FDB    $4949
00159 3DC3 31            FCB    $31        * S
00160 3DC4 0101          FDB    $101
00161 3DC6 7F01          FDB    $7F01
00162 3DC8 01            FCB    1          * T
00163 3DC9 7F40          FDB    $7F40
00164 3DCB 4040          FDB    $4040
00165 3DCD 7F            FCB    $7F        * U
00166 3DCE 1F20          FDB    $1F20
00167 3DD0 4020          FDB    $4020
00168 3DD2 1F            FCB    $1F        * V
00169 3DD3 3F40          FDB    $3F40
00170 3DD5 3840          FDB    $3840
00171 3DD7 3F            FCB    $3F        * W
00172 3DD8 6314          FDB    $6314
00173 3DDA 0814          FDB    $814
00174 3DDC 63            FCB    $63        * X
00175 3DDD 0708          FDB    $708
00176 3DDF 7008          FDB    $7008
00177 3DE1 07            FCB    7          * Y
00178 3DE2 6151          FDB    $6151
00179 3DE4 4945          FDB    $4945
00180 3DE6 43            FCB    $43        * Z
00181 3DE7 007F          FDB    $7F
00182 3DE9 4141          FDB    $4141
00183 3DEB 00            FCB    0          * [
00184 3DEC 0204          FDB    $204
00185 3DEE 0810          FDB    $810
00186 3DF0 20            FCB    $20        * \
00187 3DF1 0041          FDB    $41
00188 3DF3 417F          FDB    $417F
00189 3DF5 00            FCB    0          * ]
00190 3DF6 0402          FDB    $402
00191 3DF8 7F02          FDB    $7F02
00192 3DFA 04            FCB    4          * ^
00193 3DFB 081C          FDB    $81C
00194 3DFD 2A08          FDB    $2A08
00195 3DFF 00            FCB    0          * _
00196                    END
```

```
00540 3A35 C9 00          ADC B  #$00
00550 3A37 97 29          STA A  TBLCHR+1
00560 3A39 D7 28          STA B  TBLCHR
00570 3A3B 9E 28          LDS    TBLCHR
00580 3A3D DE 20          LDX    BUFPTR
00590 3A3F C6 05          LDA B  #$05
00600 3A41 32             PUL A
00610 3A42 A7 00          STA A  0,X
00620 3A44 08             INX
00630 3A45 5A             DEC B
00640 3A46 26 F9          BNE    *-5
00645                *1.5.3***
00660 3A48 D6 2E          LDA B  BLANKN
00680 3A4A 08             INX
00690 3A4B 5A             DEC B
00700 3A4C 26 FC          BNE    *-2
00705                *1.5.4***
00710 3A4E DF 20          STX    BUFPTR
00720 3A50 9C 2C          CPX    BUFEND
00730 3A52 26 04          BNE    CAEXIT
00740 3A54 DE 2A          LDX    BUFSTR
00750 3A56 DF 20          STX    BUFPTR
00760 3A58 9E 24     CAEXIT LDS  SCRTCH
00770 3A5A 39             RTS
00775                *TO 1.1***
00800 3A5B BD 3C4F   TESTPR JSR  INITPR
00805                *TO 1.2***
00810 3A5E 8D A0          BSR    CAINIT
00815                *1.3*****
00820 3A60 BD E1AC   INCHAR JSR  $E1AC
00830 3A63 81 0D          CMP A  #$0D
00835                *1.4.1**
00840 3A65 26 05          BNE    *+7
00845                *TO 1.4.2*
00850 3A67 BD 3C7C        JSR    LINPTR
00860 3A6A 20 F2          BRA    TESTPR+3
00865                *TO 1.5**
00870 3A6C 8D B1          BSR    CACTPB
00880 3A6E 20 F0          BRA    INCHAR
00890 3A70 CE 3A7A   GSTART LDX  #SWIEND
00900 3A73 DF 6C          STX    $6C
00910 3A75 BD 3A5B        JSR    TESTPR
00920 3A78 20 F6          BRA    GSTART
00930                * SET A048 TO GSTART FOR MONITOR ENTRY
00940 3A7A 86 80     SWIEND LDA A  #$80
00950 3A7C B7 8006        STA A  PTRDR
00960 3A7F 7E E0E0        JMP    $E0E0
01000 3C00                ORG    $3C00
01010      006A      INTVCT EQU  $006A
01020 3C00 C6 FF     DELAY  LDA B  #$FF
01030 3C02 5A             DEC B
01040 3C03 26 FD          BNE    *-1
01050 3C05 39             RTS
01060 3C06 8D 05     XDELAY BSR    BNEOTO
01070 3C08 8D F6          BSR    DELAY
01080 3C0A 8D 22          BSR    BEQOTO
01090 3C0C 39             RTS
01100 3C0D 86 14     BNEOTO LDA A  #$14
01110 3C0F B7 8007        STA A  PTRCR
01120 3C12 B6 8006        LDA A  PTRDR
01130 3C15 C6 FF          LDA B  #$FF
01140 3C17 D7 24          STA B  SCRTCH
01150 3C19 D7 25          STA B  SCRTCH+1
01160 3C1B B6 8007        LDA A  PTRCR
01170 3C1E 84 40          AND A  #$40
01180 3C20 26 0B          BNE    *+13
01190 3C22 7A 0025        DEC    SCRTCH+1
01200 3C25 26 F4          BNE    *-10
01210 3C27 7A 0024        DEC    SCRTCH
01220 3C2A 26 ED          BNE    *-17
01230 3C2C 3F             SWI
01240 3C2D 39             RTS
01250 3C2E 86 04     BEQOTO LDA A  #$04
01260 3C30 B7 8007        STA A  PTRCR
01270 3C33 B6 8006        LDA A  PTRDR
01280 3C36 C6 FF          LDA B  #$FF
01290 3C38 D7 24          STA B  SCRTCH
01300 3C3A D7 25          STA B  SCRTCH+1
01310 3C3C B6 8007        LDA A  PTRCR
01320 3C3F 84 40          AND A  #$40
01330 3C41 27 0B          BEQ    *+13
01340 3C43 7A 0025        DEC    SCRTCH+1
01350 3C46 26 F4          BNE    *-10
01360 3C48 7A 0024        DEC    SCRTCH
01370 3C4B 26 ED          BNE    *-17
01380 3C4D 3F             SWI
01390 3C4E 39             RTS
01395                *1.1*****
01400 3C4F 8D 00     INITPR BSR    *+2
01410 3C51 32             PUL A
01420 3C52 33             PUL B
01425                *1.1.1**
01420 3C53 CB 6E          ADD B  #$6E
01430 3C55 97 26          STA A  TBLADR
01440 3C57 D7 27          STA B  TBLADR+1
01445                *1.1.2***
01450 3C59 7F 8007        CLR    PTRCR
01460 3C5C 86 FF          LDA A  #$FF
01470 3C5E B7 8006        STA A  PTRDR
01480 3C61 86 04          LDA A  #$04
01490 3C63 B7 8007        STA A  PTRCR
01495                *1.1.3**
01500 3C66 86 00          LDA A  #$00
01510 3C68 B7 8006        STA A  PTRDR
01520 3C6B 8D 99          BSR    XDELAY
01525                *1.1.4**
01530 3C6D 8D 49          BSR    LINEND+3
01535                *1.1.5***
```

```
00010                        NAM    PRDRVR
00015                * COPYRIGHT 1978 EPA  1/16/78
00020 3A00                   ORG    $3A00
00030                        OPT    MEM
00040       0022     CHRCNT  EQU    $22
00050       0024     SCRTCH  EQU    $24
00060       0023     SPTSIZ  EQU    $23
00070       0026     TBLADR  EQU    $26
00080       0028     TBLCHR  EQU    $28
00090       002A     BUFSTR  EQU    $2A
00100       0020     BUFPTR  EQU    $20
00110       002C     BUFEND  EQU    $2C
00120       002E     BLANKN  EQU    $2E
00130       3E80     BUFLOC  EQU    $3E80
00140       8006     PTRDR   EQU    $8006
00150       8007     PTRCR   EQU    $8007
00195                *1.2*****
00200 3A00 CE 3E80   CAINIT  LDX    #BUFLOC
00205                *1.2.1***
00210 3A03 DF 2A             STX    BUFSTR
00220 3A05 DF 20             STX    BUFPTR
00230 3A07 96 22             LDA A  CHRCNT
00240 3A09 97 24             STA A  SCRTCH
00250 3A0B 86 00             LDA A  #$00
00260 3A0D D6 2E             LDA B  BLANKN
00270 3A0F CB 05             ADD B  #$05
00275                *1.2.2***
00280 3A11 A7 00             STA A  0,X
00290 3A13 08                INX
00300 3A14 5A                DEC B
00310 3A15 26 FA             BNE    *-4
00320 3A17 7A 0024           DEC    SCRTCH
00330 3A1A 26 F1             BNE    *-13
00335                *1.2.3***
00340 3A1C DF 2C             STX    BUFEND
00350 3A1E 39                RTS
00355                *1.5*****
00400 3A1F 9F 24     CACTPB  STS    SCRTCH
00410 3A21 80 20             SUB A  #$20
00415                *1.5.1***
00420 3A23 2D 33             BLT    CAEXIT
00430 3A25 81 3F             CMP A  #$3F
00435                *1.5.1***
00440 3A27 2E 2F             BGT    CAEXIT
00445                *1.5.2***
00450 3A29 0C                CLC
00460 3A2A 16                TAB
00470 3A2B 48                ASL A
00480 3A2C 48                ASL A
00490 3A2D 1B                ABA
00500 3A2E D6 26             LDA B  TBLADR
00510 3A30 C9 00             ADC B  #$00
00520 3A32 0C                CLC
00530 3A33 9B 27             ADD A  TBLADR+1
```

```
01540 3C6F 86 01             LDA A  #$01
01550 3C71 97 23             STA A  SPTSIZ
01560 3C73 86 2C             LDA A  #$2C
01570 3C75 97 22             STA A  CHRCNT
01580 3C77 86 02             LDA A  #$02
01590 3C79 97 2E             STA A  BLANKN
01600 3C7B 39                RTS
01700 3C7C 0F        LINPTR  SEI
01705                *1.4.2**
01710 3C7D 86 00             LDA A  #$00
01720 3C7F B7 8006           STA A  PTRDR
01730 3C82 8D 82             BSR    XDELAY
01735                *1.4.3.1*
01740 3C84 DE 2A             LDX    BUFSTR
01745                *1.4.3.2*
01750 3C86 A6 00     LINLUP  LDA A  0,X
01760 3C88 B7 8006           STA A  PTRDR
01765                *1.4.3.3*
01770 3C8B D6 23             LDA B  SPTSIZ
01780 3C8D 37        CHRLUP  PSH B
01790 3C8E B6 8006           LDA A  PTRDR
01795                *1.4.3.4*
01800 3C91 C6 0F             LDA B  #$0F
01810 3C93 D7 24             STA B  SCRTCH
01820 3C95 D7 25             STA B  SCRTCH+1
01830 3C97 B6 8007           LDA A  PTRCR
01835                *1.4.3.5*
01840 3C9A 2B 0B             BMI    *+13
01845                *1.4.3.6*
01850 3C9C 7A 0025           DEC    SCRTCH+1
01860 3C9F 26 F6             BNE    *-8
01870 3CA1 7A 0024           DEC    SCRTCH
01880 3CA4 26 EF             BNE    *-15
01890 3CA6 3F                SWI
01895                *1.4.3.7*
01900 3CA7 33                PUL B
01910 3CA8 5A                DEC B
01920 3CA9 26 E2             BNE    CHRLUP
01925                *1.4.3.8*
01930 3CAB 08                INX
01940 3CAC 9C 2C             CPX    BUFEND
01950 3CAE 26 D6             BNE    LINLUP
01955                *1.4.3.9*
01960 3CB0 86 00             LDA A  #$00
01970 3CB2 B7 8006           STA A  PTRDR
01975                *1.4.4.1*
01980 3CB5 BD 3C0D   LINEND  JSR    BNEOTO
01985                *1.4.4.5*
01990 3CB8 86 80             LDA A  #$80
02000 3CBA B7 8006           STA A  PTRDR
02010 3CBD 0E                CLI
02020 3CBE 39                RTS
02030                        END
```

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# BOOK REVIEWS

## HOW TO PROGRAM MICROCOMPUTERS

**By William Barden Jr.**
**Howard W. Sams & Co. Inc.**

*Review by Roger H. Edelson, Hardware Editor*

In one book, William Barden Jr. has managed to provide a guide to assembly language programming for three of the major microprocessor chips available to the hobbyist: the 8080, the 6800 and the 6502. The book is written for the beginning programmer but the coverage is quite extensive, ranging from data manipulation at the bit level up to data handling of tables and lists, and from simple logical/numerical operations up to floating point operations. The programming algorithms and subroutines presented in Part 4 alone are almost worth the $8.95 asking price for the book.

The book is divided into four parts: Basic Concepts, Microcomputer Architecture and Operation, Assembly Language Programming with Microcomputers, and the previously mentioned Programming Algorithms.

Part 1, Basic Concepts, contains five chapters of introductory material that may be skipped by a person already acquainted with number systems, logical operations, one's and two's complement representation, and microcomputer data codes. The author's style in these first chapters is anything but pedantic; it is quite intriguing and very readable.

In Part 2 we are introduced to the architecture of three microcomputers. We then proceed through discussion of addressing modes and stack/memory operation. In Chapter Nine the instruction repertoire of each of the three microprocessors is covered.

Part 3, the heart of the book, covers the actual assembly language programming of the three microprocessor chips. Suffice it to say there is a tremendous wealth of information here. Double-precision, decimal, and floating-point arithmetic are just some of the subjects covered. Bit processing and manipulation and list processing, including bubble sorts, are also presented.

Barden could be congratulated on having produced such an excellent book even if it only covered one microprocessor; the inclusion of three of the major devices in use by the hobbyist is icing on an already tasty cake.□

## MICROPROCESSORS

**By Rodnay Zaks. Sybex**

*Review by Roger H. Edelson, Hardware Editor*

This book is an introductory text covering both the components of microprocessors and their combination into systems. As such it does a remarkably good job, considering the breadth of the subject. The author has taught microprocessor design for many years, and this text represents the seventh version of one such course, plus the inclusion of material from seminars and other publications by Zaks.

Because of this extensive prior use and arrangement of the material, the book is quite cohesive and self-sufficient, with each chapter building on the information presented in the preceding ones. The major problem with a book of this breadth is, of necessity, the rather broad brush treatment some subjects are given.

The book begins with the first chapter devoted to fundamental concepts and definitions, including an introduction to LSI device processing and a brief history of the microprocessor and Silicon Valley.

In Chapter 2 Zaks presents the internal operation of a microprocessor covering LSI constraints and architecture (including single and multiple bus structure). The 8080 is used as a case study to illustrate the concepts of this chapter, which is one of the best in the book and is recommended for beginners and more advanced readers.

Chapter 3 covers the additional LSI system peripheral chips, including memories and I/O techniques and devices. The major emphasis is on I/O and memories.

The chapter on comparative microprocessor evaluation is essentially qualitative and nowhere near the level it could be. It does, however, provide introductory level discrimination between the different devices.

Chapters 7 and 8 are two more high points of the text. Chapter 7 does an excellent job of covering microprocessor interfacing. This chapter contains a very good presentation of the IEEE 488 interface bus, but the coverage of the S-100 is quite skimpy. Chapter 8, on microprocessor programming, is also well done with excellent presentation of the material on addressing techniques and assembly language programming.

On balance, this book provides an excellent text for persons who have little or no knowledge of parts of the microprocessor world. It can be used by most persons involved in microprocessors and is easy to read because of its progressive style.□

## SCIENTIFIC AND ENGINEERING PROBLEM-SOLVING WITH THE COMPUTER

**By William Ralph Bennett Jr.**
**Prentice-Hall, Inc.**

*Review by Roger H. Edelson, Hardware Editor*

This book provides an excellent tutorial on BASIC programming within an introductory computer applications course. The two chapters on BASIC alone are worth the price, but the following chapters on applications are truly mind boggling. The discussions range from the classic "monkeys at the typewriters problem," Edgar Allan Poe, to the Watergate Problem. The writing and style are exceedingly readable and entertaining and the book should be of interest to any student of computer applications, be they in the physical sciences or the humanities.

The first three chapters are devoted mainly to introductory material to enable the student to tackle the more difficult and interesting problems posed in the later chapters.

Chapter 1 is devoted to the elementary concepts of BASIC programming. It is designed for people who have never seen or touched a computer terminal, but it manages to cover loops, variables, rounding (or the INT function), sorting techniques, and some string operations.

In Chapter 2, more advanced concepts of BASIC programming are covered with the emphasis on matrix operations and various series summations. Chapter 3 discusses plotting and graphical display with particular emphasis on the type of a teletype terminal.

Problems involving dynamics are discussed in Chapter 5. To illustrate the air-resistance problems, the classic Princeton-Dartmouth football game of 1950 is used. It seems the game was played during a hurricane and winds of 60 to 90 mph were present. Some truly outstanding trajectories were produced, with the opening kickoff nearly resulting in a field goal. The chapter continues with rocket travel problems, electric and magnetic field dynamic problems, cyclotrons, magnetic bottles and much more.

This book is so interesting that you will enjoy reading it even if you have no interest in a computer. The references at the end of each chapter provide a plethora of information on books which expand on the subject.□

## HOME COMPUTER: $2^{10}$ QUESTIONS AND ANSWERS Volume 2: Software

**By Rich Didday. dilithium Press**

*Review by Roger H. Edelson, Hardware Editor*

Reading the publisher's blurb on the back of this book, I assume Rich Didday is a programmer rather than a hardware type. For this reason, this volume is more detailed than Volume 1, which discussed hardware.

To a very worthwhile degree, this book does provide the reader with a real feeling for what it is like to write programs for home computers. It will not make you a programmer in either BASIC or assembly language, but it will provide you with enough insight into software to allow intelligent consideration of various software alternatives.

In looking at the chapters (or Days as the book calls them) to see what is covered, I found Day 5 was a repeat of the same chapter from Volume 1, to provide continuity and an introduction to software. Other information presented in Volume 1, relevant to this book, has also been included. In Day 6 Didday introduces the reader to programming in machine and assembly languages. In this chapter subroutines are discussed and a multiplication subroutine is written in 8080 assembly language.

In Days 9 and 10 programming generalities and the capabilities and limitations of the computer are discussed, but these last chapters do not live up to the earlier portion of the volume.

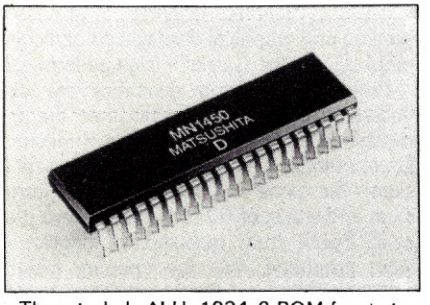
On the whole, however, Volume 2 provides a very good introduction to the software aspects of home computers.□

# NEW PRODUCTS

## MICROCOMPUTERS

### Ultra-Low Power Microcomputer

A new single-chip, ultra-low power (2 milliwatts typical) CMOS 4-bit microcomputer is available from the Electronic Components Division of Panasonic Company. The MN1450 comes in a 40-pin standard DIL plastic package offering a number of "on-chip" functions.




These include ALU, 1024x8 ROM for storing instructions, 64x4 data RAM with 4 words that are directly addressable, 8-bit counter/timer, and more. For more information contact Panasonic, One Panasonic Way, Secaucus, NJ 07094.

**CIRCLE INQUIRY NO. 121**

### Monoboard Microcomputer Micromodules

The M68MM01B is a stand-alone microcomputer that has all the processing control power of an MC6802 MPU with its self-contained clock circuit and 128 bytes of static RAM. The module contains sockets for up to 4K of EROM or ROM for programming, a PIA for parallel data transfers and a programmable timer module.

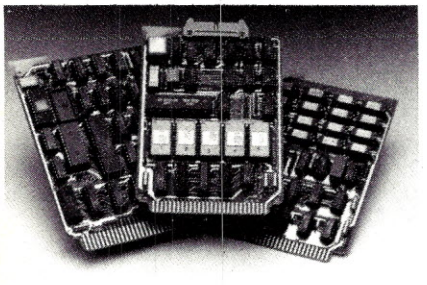
The M68MM01B1A is a more fully-populated version of M68MM01B, with an additional 256 bytes of static RAM, provisions for off-board dynamic memory refresh, an ACIA with RS-232C interface circuits, an audio tape cassette interface circuit and bus drivers for the address, data and control bus signals.

The unit price (1-9) of M68MM01B is $286; and M68MM01B1A is $495 each. For more information contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036, (602) 962-2223, microsystems marketing.

**CIRCLE INQUIRY NO. 122**

### OEM Microcomputer Boards

The Micro Design Series consists of two types of Z-80 based modules: a bus-compatible line designated MDX™, as well as a stand-alone microcomputer line, designated MD™.



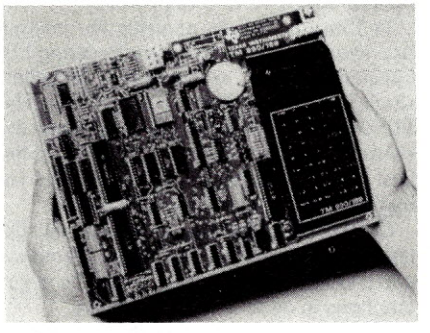
The MDX cards are modularized by function, including a CPU card; three dynamic RAM cards (8K, 16K, and 32K); serial I/O; parallel I/O; combination EPROM and UART; and software development/debug. All cards measure only 4.5" x 6.5" and are available in 2.5MHz or 4MHz versions.

Prices in 100-lot quantities range from $164 to $410. For more information contact Mostek Corp., 1215 W. Crosby Rd., Carrollton, TX 75006.

**CIRCLE INQUIRY NO. 123**

### Single-Board Microcomputer

The TM990/189M microcomputer system is designed as a low-cost, completely assembled learning aid for hands-on experience plus instruction in microcomputer fundamentals.



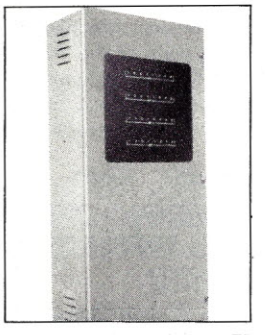
The board is totally self-contained with 1K bytes of RAM and 4K bytes ROM. Mass memory storage can be accomplished via the audio cassette interface.

Price is $299. For details contact Texas Instruments Inc., IAS, P.O. Box 1443 M/S 653, Houston, TX 77001, Attn: TM990/189.

**CIRCLE INQUIRY NO. 124**

### Series RCU 400 Micro

The Series RCU 400 microcomputer based remote control unit is designed to monitor digital and analog input signals, transmit data over telephone lines to a host computer, receive instructions back, and execute local control in the event of a communications failure.



Program storage is provided by EPROM and data storage is provided by RAM. Maximum system configuration allows up to 32K of EPROM and up to 32K of RAM.

For more information contact Detection Sciences, Inc., Digital Systems Div., 14050 21st Ave. N., Minneapolis, MN 55441.

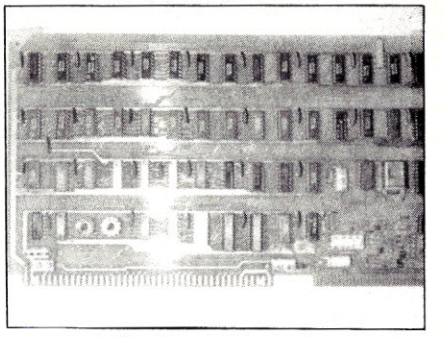
**CIRCLE INQUIRY NO. 125**

## PERIPHERALS

### Timekeeping Module

The MC1460 clock/calendar module provides data and time data through input ports. Fully compatible with any Intel SBC or National BLC series system, the MC1460 uses low power circuitry to allow the date and time to be powered by an external source during system power down.

The MC1460 can satisfy many interval timer requirements with its software selectable periodic interrupts. Available interrupt rates range from every 10 milliseconds to once per day.



Price is $425. For details contact Canada Systems, Inc., P.O. Box 516, La Canada, CA 91011.

**CIRCLE INQUIRY NO. 126**

### The Apple Clock

This Real-Time Calendar/Clock for Apple II computers keeps time and date in 1ms increments continuously for over one year. Calendar, clock, and event timer functions are accessed from BASIC using routines carried in an on-board ROM.

Some features are: crystal controlled for accuracy, on-board rechargeable battery to keep the clock running during computer down times, intentional and otherwise. Software for calendar and clock routines, as well as an event timer are contained in an on-board ROM. An interrupt feature is provided which can be programmed to make efficient use of computer time.

Unlimited applications: Program a morning printout of appointments; date transactions; create games in which elapsed time is important. Time events.

Price of the Apple Clock is $199 assembled and tested. Delivery is stock to 30 days. For more information contact Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060, (408) 429-8600.

**CIRCLE INQUIRY NO. 127**

### S-100 Calendar/Clock

Add Real-Time Calendar/Clock capabilities with Mountain Hardware's 100,000 Day Clock™ for S-100 computers.

Several features make this Calendar/Clock unique: crystal-controlled for accuracy; on-board rechargeable battery to keep the clock running during computer down times, intentional or not.

Keep time and date in 100 us increments for periods as long as 100,000 days. Easy to set by entering BCD digits at each time port. The clock stops when the first digit is entered and starts again on the first "READ" command. A "Write Protect" switch prevents the clock from being accidentally stopped or changed. The clock can be used with most BASICs.

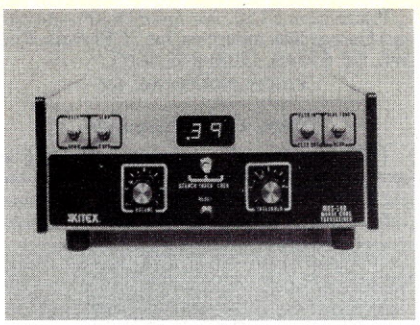
Price of the 100,000 Day Clock is $219 assembled and tested. Delivery is stock to 30 days. For more information, contact Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060, (408) 429-8600.

**CIRCLE INQUIRY NO. 128**

### Morse Code Transceiver

The MRS-100 Morse Code Transceiver is designed around a preprogrammed single chip microcomputer for the generation and reception of Morse code signals, using a standard ASCII or Baudot terminal.

The microcomputer's on-chip 2048 byte ROM memory contains both the Send and Copy algorithms, plus a software UART with multiple ASCII and Baudot baud rates. All timing signals are generated internally from a single external 4MHz crystal.

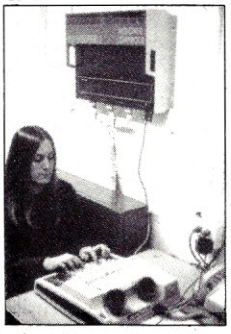


Price for partial kit including microcomputer and blank P.C. boards is $95; full kit (less terminal) is $225; assembled and tested $295. For more information contact Xitex Corp., 13628 Neutron, Dallas, TX 75240, (214) 386-3859.

**CIRCLE INQUIRY NO. 129**

### Energy Controller

Sunkeeper/J is a user programmable, microprocessor based energy management system that centrally controls functions such as heating, lighting, ventilation, and air conditioning to reduce energy costs.



Easily interfaced to existing electrical systems by standard electrical hardware, it accepts 16 analog inputs provided by thermistor temperature sensors, and 16 digital inputs. The system provides 16 digital outputs.

Price is less than $4900. For more information contact Andover Controls Corp., P.O. Box 34, Shawsheen Village Sta., Andover, MA 01810, (617) 470-0555, W.A. Lendh, Nat'l Sales Mgr.

**CIRCLE INQUIRY NO. 130**

### EPROM Eraser

The C-91 MEMORASE® is a UV cabinet that offers fast complete erasure of up to 96 EPROMs in one batch in under 7 minutes. The system provides speed, economy, and unprecedented performance with one-step operation.



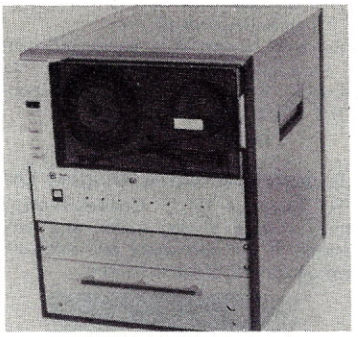
No preoperative adjustments or tuning necessary. The light source utilizes over 7 feet of pure quartz tubing to give maximum even output at 254nm without destructive hot spots.

For more information contact Ultra-Violet Products, Inc., 5100 Walnut Grove Ave., San Gabriel, CA 91778.

**CIRCLE INQUIRY NO. 131**

### Magnetic Tape Systems

The 3000 Series ½" magnetic tape systems are Intel SBC, MDS to IBM, ANSI compatible. The systems consist of an asynchronous parallel I/O processor (GPIB Controller), which plugs directly into any Intel Multibus.



From the GPIB, a dedicated microprocessor performs all programming, formatting, and error detection functions. This provides the users of Intel, Multibus, a simple and easy way of adding IBM, ANSI compatible ½" magnetic tape as a storage and transfer medium.

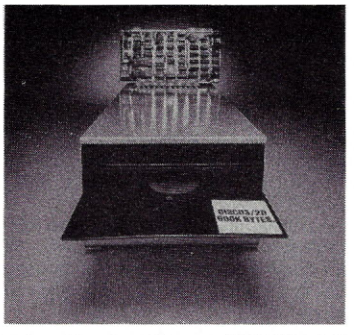
A complete system with tape drive, ready for the Intel Multibus and providing over 30 megabytes of storage, is priced at $9,950. Available from Dylon Corporation, Model 3100-9-1600-45. For more information contact Dylon Corp., 3670 Ruffin Rd., San Diego, CA 92123.

**CIRCLE INQUIRY NO. 132**

## DISKS

### DISCUS 2D

Discus 2D is a full-size, single/double density S-100 disk system capable of storing up to 600K bytes of data on each side of a diskette which is formatted to be compatible with the IBM System 34. The Discus 2D comes fully assembled with a con-



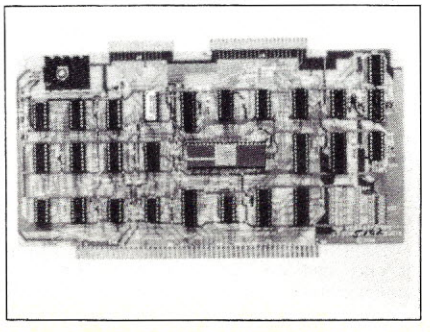
troller board and a Shugart SA800R full-size drive mounted in a cabinet with a power supply.

Software includes BASIC-V virtual disk BASIC, DOS and Disk/ATE assembler and editor. Price is $1,149. For details contact Thinker Toys, 1201 Tenth St., Berkeley, CA 94710.

**CIRCLE INQUIRY NO. 133**

### Versafloppy

Versafloppy from SD Systems is now being offered in a fully assembled, tested and burned in version for OEM users. The Versafloppy operates with other S-100 compatible boards to form a complete disk based computer system.

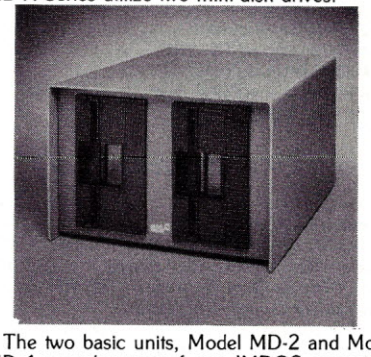


Highlight features of Versafloppy are IBM 3740 soft sectored format, controls up to four mini or full size drives, interrupt operational optional, full line software available, and double sided operation. For more information contact SD Systems, P.O. Box 28810, Dallas, TX 75228.

**CIRCLE INQUIRY NO. 134**

### Mini-Disk Systems

Imsai Manufacturing Corporation now offers the MD-X Floppy Mini-Disk System, featuring 40- and 77-track, single/double density, 5¼-inch floppy disk drives. All models of the MD-X Series utilize two mini-disk drives.



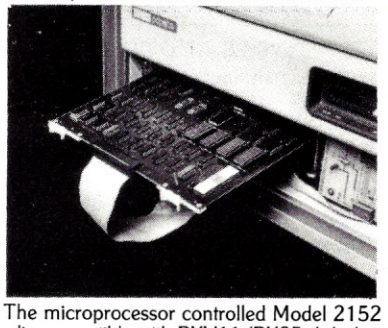
The two basic units, Model MD-2 and Model MD-4 may be part of any IMDOS-compatible configuration. Models MD-2E and MD-4E are expansion units for the MD-2 and MD-4, as well as for Imsai mini-disk based computers.

For more information contact Imsai Manufacturing Corp., 14860 Wicks Blvd., San Leandro, CA 94577, (415) 483-2093.

**CIRCLE INQUIRY NO. 135**

### Compact Disk Cartridge Controller

The GEN/COMP Model 2152 Disk Cartridge Control is a single, quad-height 4-layer PC board that provides 2.5 to 20 MByte storage. The compact moving head disk cartridge control operates with DEC, Pertec Diablo and similar drives.



The microprocessor controlled Model 2152 is media compatible with RKV11/RK05 disk drives.

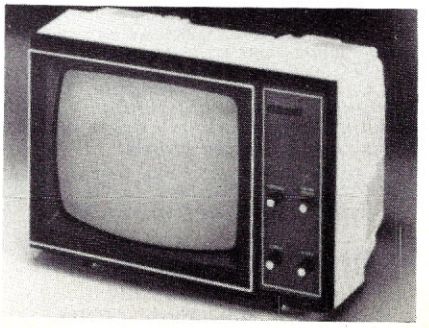
Price is $1,500 including disk drive cable. For more information contact Gen/Comp Inc., 6 Algonquin Rd., Canton, MA 02021, (617) 828-2008, Gerald Nutter.

**CIRCLE INQUIRY NO. 136**

## TERMINALS

### Low-Cost Video Terminal

A black and white, low-cost 12-inch video terminal is available for home, personal or business computer systems and/or surveillance monitors.



# SUPER BUYS ON MEMORY BOARDS

| | LIST | OUR PRICE |
|---|---|---|
| Dynabyte 16K Static RAM, 250ns | | $359 |
| 32K Static RAM, 250ns | $995 | 796 |
| Morrow SupeRAM 16K Static 450ns, Kit | $299 | $269 |
| SupeRAM, 16K, 4 MHz, Kit | $334 | 304 |
| SupeRAM, 32K, 4 MHz, Kit | $649 | 579 |
| North Star 16K Dynamic, Kit | $399 | $269 |
| SD Computer ExpandoRAM w/o RAMS (no chips) | | $139 |
| 32K Dynamic w/8K, Kit | | 189 |
| 32K Dynamic w/16K, Kit | | 237 |
| 32K Dynamic w/32K, Kit | Special | 329 |
| Vector 48K Static, Assm. | $695 | $589 |

## FLOPPY DISK INTERFACES

| | | |
|---|---|---|
| Morrow Discus I | $995 | $849 |
| Discus I (dual drive) | 1795 | 1499 |
| Discus I/2D (double density) | 1149 | 979 |
| Disk Jockey I Controller Board | | 169 |
| Tarbell Floppy Disk Interface | $190 | $169 |
| Micromation Doubler, double-density controller | $495 | $419 |
| Megabox dual-drive dbl. density system, over 1 megabyte | 2295 | 2054 |
| Mega II, over 2 megabytes | 2995 | 2695 |
| SD Computer VersaFloppy floppy disk controller board, kit | $159 | 139 |
| Micropolis 1041 MacroFloppy | $695 | $625 |
| 1042 MacroFloppy w/case & P.S. | | 709 |
| 1053 Dual MetaFloppy | 1895 | 1695 |

*INTRODUCTORY SPECIAL*
*fantastic new Xitan Disk Controller Board single and double density, handles mini- and standard-size drives simultaneously, complete with CP/M compatible DOS and Xitan disk BASIC. Assm./tested*
*List $595* **OUR PRICE: $499**

## TERMINALS AND PRINTERS

| | | |
|---|---|---|
| Perkin-Elmer Bantam 550 — upper/lower case, 24x80 format | $996 | $799 |
| w/anti-glare screen (specify gray or green) | | 819 |
| Hazeltine 1500 | | $1049 |
| 1400 | | 699 |
| Soroc 120 | | $849 |
| Intertube | | $784 |
| Lear Siegler ADM3A, assm. | | $849 |
| Kit | | 775 |
| Teletype 43 RO, TTL (serial) | | $874 |
| 43 KSR/Terminal, TTL (serial) | | 979 |
| T.I. 810 Printer | | $1695 |
| Centronics 779 w/tractor | | $995 |
| IP-125 Brightwriter w/1210 print control option | | $754 |
| IP-225 w/1210 & 1250 options | | 889 |
| DecWriter II | | $1490 |
| Printerm 879, 120cps Friction-feed model | | $1099 |
| Pin-feed model | | 1199 |
| RS232 Cables | | $25 |

*Call for quotation on Diablo, NEC Spinwriter, and others.*

SHIPPING, HANDLING & INSURANCE:
Add $2 for boards, $7.50 for floppy disk system; contact us for terminal & printer shipping information.

*Prices in this ad include 2% cash prepayment discount (bank transfer, check, money order, etc. VISA and Master Charge accepted, but 2% cash discount does not apply. Slightly higher prices apply to government and institutional purchase orders when not prepaid. OEM and dealer inquiries invited.*

*Above prices subject to change and all offers subject to withdrawal without notice.*

*— WRITE FOR FREE CATALOG —*

**MiniMicroMart, Inc.**
1618 James Street
Syracuse, New York 13203
**(315) 422-4467 TWX 710 541-0431**

**CIRCLE INQUIRY NO. 86**


The monitor is lightweight, features solid state circuitry, and is compatible with many computer systems. Other advantages include composite video input, video bandwidth of 12 MHz ± 3dB, and 75 ohm input impedance.

Price is $139 plus $5 for handling & handling. For more information contact Micro Products Unlimited, P.O. Box 1525, Arlington, TX 76010, (214) 461-8043.

**CIRCLE INQUIRY NO. 137**

### Industrial Control/Display Unit

The Termiflex HT/7 Control/Display unit features a large display buffer, and simplifies operation of microprocessor and minicomputer based equipment and test systems.



The unit incorporates an easy to read 2 line display of twenty 0.15"H characters per line and a buffer that permits display of up to 960 characters. The message can be scrolled at the touch of a switch.

Price is $2,595 (1-9). For more information contact Termiflex Corp., 17 Airport Rd., Nashua, NH 03060, (603) 889-3883, Peter Clark.

**CIRCLE INQUIRY NO. 138**

### Computer Graphic Terminal

The 8500M Intelligent Graphics Terminal uses the power of beam addressed solid-state image memory. The Lithicon solid-state addressed image memory plane contains over four million micro-capacitor elements, providing high resolution performance.

An innovation in raster graphics, the terminal offers smooth, continuous, high resolution graphics without stairstepping. It uses a 4096 by 3072 viewable window and has an addressable field of 8192 by 8192 points.

The unit has many optins which make it flexible and versatile: floppy disk, MT cassette, digitizer, APL keyboard, additional image memories, high speed gray scale interfacing, additional character RAM and more.

For additional information contact Princeton Electronic Products, P.O. Box 101, No. Brunswick, NJ 08902, (201) 297-4448.

**CIRCLE INQUIRY NO. 139**

### Keyboard Subsystem

The Model 771 Keyboard Subsystem is designed especially for personal, small business, and educational microcomputer systems. The keyboard includes 56 alphanumeric keys which provide the entire 128 character ASCII set.



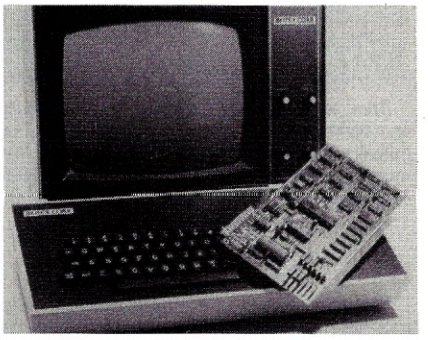
Standard features include auto-repeat, two-key tollover, and fully buffered outputs. The 771 is equipped with a parallel interface and D series connector.

Priced from $150. For more information contact George Risk Industries, Inc., GRI Plaza, Kimball, NE 69145, (308) 235-4645.

**CIRCLE INQUIRY NO. 140**

### Xitex CRT Terminal

This complete video terminal is designed around a preprogrammed single chip microcomputer and the popular SCT-100 stand alone video terminal board using the ASCII or Baudot.



The heart of this product is the Xitex SCT-100 stand alone video terminal board that converts the parallel ASCII keyboard input to video output. The display of 64 characters by 16 lines is crystal controlled for a non-jittery display.

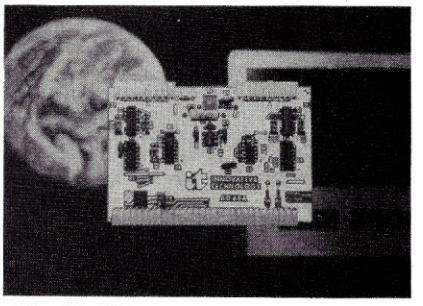
Kit price is $280; $349 assembled and tested. For details contact Xitex Corp., 13628 Neutron Rd., Dallas, TX 75240, (214) 386-3859.

**CIRCLE INQUIRY NO. 141**

## I/O BOARDS

### Analog to Digital Converter

The AD-68A is an 8-channel analog to digital converter which occupies one I/O slot in a SWTPC 6800 type computer. It allows the computer to measure analog signals from 0 to 2.50 volts with a resolution of 10 millivolts.



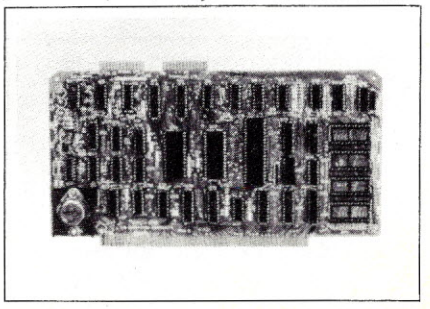
The AD-68A uses single ramp, elapsed time method of conversion with the computer providing control. The AD-68A comes with complete documentation including the driver subroutine, BASIC program example, and schematic.

Price is $39.95 assembled and tested. For more information contact Innovative Technology, 510 Oxford Park, Garland, TX 75043.

**CIRCLE INQUIRY NO. 142**

### SBC-100 Single Board Computer

SD Systems has the Z-80 microprocessor based SBC-100 Single Board Computer. The SBC-100 is designed to be used without a front panel and replaces many lower level CPU boards.



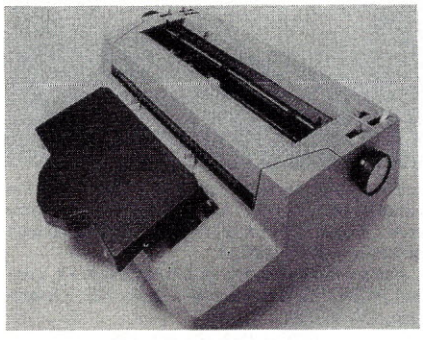
A full single board computer, the SBC-100 offers features that allow it to be coupled with a controller interface to give a complete control unit for industrial applications. The board features 1K onboard RAM, 8K bytes PROM (2716), RS-232 serial I/O, four channel counter/timer and more.

For more information contact SD Systems, P.O. Box 28819, Dallas, TX 75228.

**CIRCLE INQUIRY NO. 143**

### Mechanical Interface

The I/O Pak is designed to permit generation of hard copy directly from computers through electric typewriters. The interface can be used with portable electric typewriters as well as standard office machines.



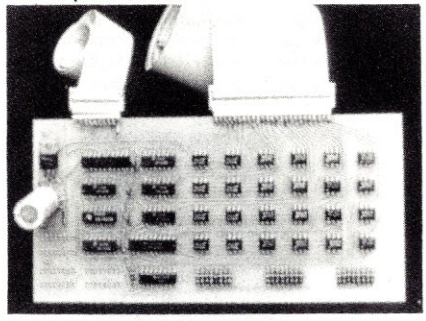
Hard copy is generated in both upper and lower case characters. Quality is consistent with the typewriter used. The I/O Pak incorporates an array of specially designed solenoids positioned in the same pattern as the electric typewriter's keyboard. The I/O Pak is easily installed on typewriters with powered carriage returns.

For more information contact Rochester Data, Inc., 3100 Monroe Ave., Rochester, NY 14618.

**CIRCLE INQUIRY NO. 144**

### Control Board for PET

The CTLR-216 interface card is for use on Commodore's PET computers as a process controller for medium duty applications, for stepper motor operated devices.



A software driver module is included containing eight commands which facilitate control of two steppers, eight heavy duty relays or triacs, and eight input sense lines.

Price is $199. For more information contact NANCO Diversified Design, 8380 Vickers St., Suite E, San Diego, CA 92111.

**CIRCLE INQUIRY NO. 145**

### Serial Lineprinter Interface

A new lineprinter handler for the RT-11 operating system communicates via any DLV11 interface. The serial data transmit and receive lines are all that are required. Functions are identical to those of the standard RT-11/V3B LP handler. Throughput is limited only by the printer.

A personality module plugs into the printer and accepts a 25-pin RS-232 connector from the computer. Modules for the Texas Instruments 810 Lineprinter are currently available. Software is distributed on floppy disks.

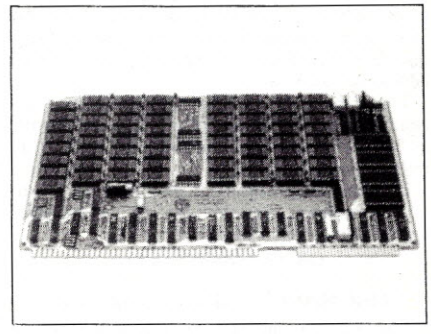
Price is $120. Delivery is one week. For more information contact Salcris Corp., P.O. Box 43247, Birmingham, AL 35243.

**CIRCLE INQUIRY NO. 146**

## MEMORY BOARDS

### Multibus Compatible Memory

The Datacube CM-118 is an Intel Multibus compatible memory that prvides 32K of static RAM in two individually addressable 16K banks, and sockets for 8K of 2716 ROM/EPROM or equivalent memories. PROM sockets can be individually enabled/disabled.



Access time is programmable from 1 to 16 times the period of the constant clock on the bus. Inhibit 1/Inhibit 2 logic and 20-bit address decode are standard.

Prices start at $950 (1-9). For more information contact Datacube SMK, Inc., 670 Main St., Reading, MA 01867, (617) 944-4600, J. Dunn.

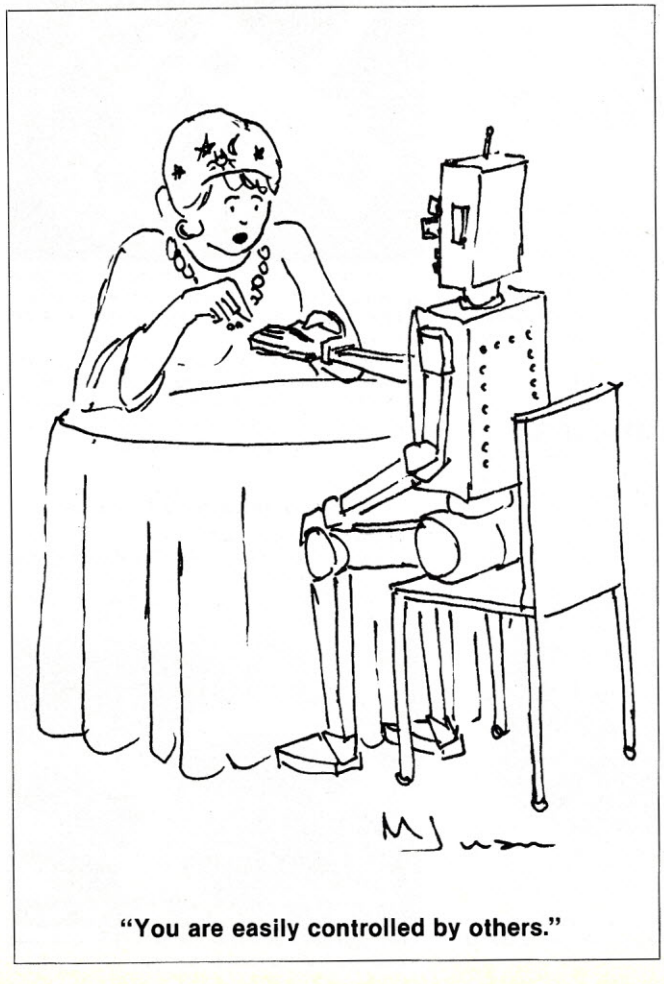
**CIRCLE INQUIRY NO. 147**

### 48K Dynamic RAM Board

The board features complete compatibility with Z-80 based, S-100 bus microsystems, and incorporates the Z-80 refresh mode for problem-free transparent refresh.

Price is $695 fully assembled. For details contact Vector Graphic Inc., 31364 Via Colinas, Westlake Village, CA 91361, (213) 991-2302.

**CIRCLE INQUIRY NO. 148**



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**CIRCLE INQUIRY NO. 12**

### 16KS Static RAM Card

Advanced Memory Technology has just introduced a fully-static, 16KS NMOS RAM card conforming to the proposed IEEE Standard for S-100 bus systems.

The Vanguard 16KS features an NMOS memory array with full address, data and control signal buffering with on-board voltage regulation. The board is configured with four 4K x 8 blocks assignable to any one of sixteen 4K address blocks within a 64K address margin. Each 4K block is also separately write-protectable. RAM disable is provided for multiplexing with ROM or additional RAM banks.

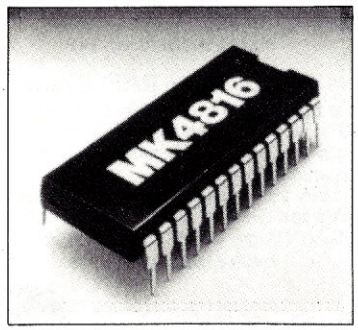
The Vanguard 16KS uses 2114 series chips rated at either 250ns or 450ns. All components, as well as completed assemblies, receive full burn-in and testing.

For more information contact Advanced Memory Technology, 480 Mercury Dr., Sunnyvale, CA 94086, (408) 736-3860.

**CIRCLE INQUIRY NO. 149**

### 16K RAM for Microcomputers

The +5 volt-only 16K RAM designed for use with microcomputers is organized as 2Kx8 for wide word applications. The MK4816 offers a collection of features to simplify system design and operation.




The MK4816 uses a dynamic periphery and a one transistor storage cell to reduce die size as well as power dissipation.

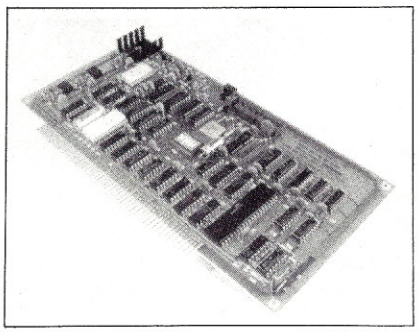
Prices start at $35.16 in 100-piece quantities. For more information contact Mostek Corp., 1215 W. Crosby Rd., Carrollton, TX 75006.

**CIRCLE INQUIRY NO. 150**

## MODEMS

### MM-103 Modem

The MM-103 is an S-100 bus compatible data modem/communications adapter; the first S-100 modem approved by the FCC for direct connection to the public switched telephone network without the use of a DAA.



The MM-103 allows the microprocessor hobbyist or small system house to obtain a commercial quality communications capability at an affordable price.

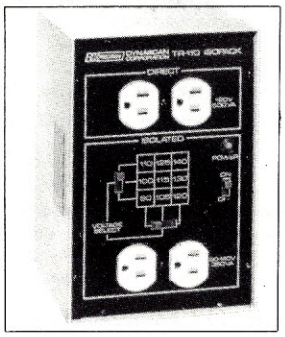
Price is $319.95 ready to use. For more information contact Potomac Micro-Magic, Inc., P.O. Box 11149, Alexandria, VA 22312.

**CIRCLE INQUIRY NO. 151**

## TEST EQUIPMENT

### Isolation Transformer

The TR-110 Isopack eliminates a shock hazard in the testing of transformerless equipment. Designed for use in industrial, school or shop testing applications, the TR-110 features both direct voltage and dual isolated outputs.



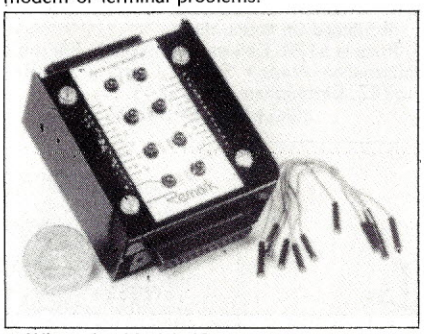
In addition the unit reduces the possibility of damage to AC-powered test instruments due to improper ground connections.

Price is $75. For more information contact B&K-Precision, 6460 W. Cortland St., Chicago, IL 60635, (312) 889-9087.

**CIRCLE INQUIRY NO. 152**

### Data Line Monitor

The Model 40 Data Line Monitor provides fast visual indication of prime data communications signals of an EIA RS232 interface for isolating modem or terminal problems.



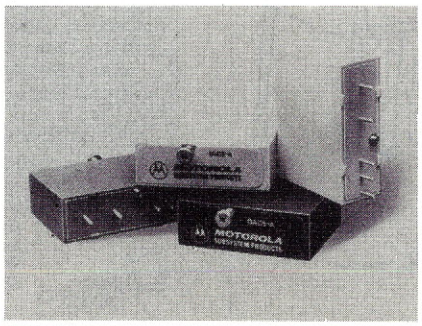
When the Model 40 is inserted between the data terminal equipment and the data transmission equipment, it continuously monitors and displays eight lines of the EIA-RS232 data path.

Price is $85 in single quantity. Delivery is 30 days ARO. For more information contact Remark International, 4 Sycamore Dr., Woodbury, NY 11797, (516) 367-3806.

**CIRCLE INQUIRY NO. 153**

## POWER SUPPLIES

The IAC5-A (input) and OAC-5A (output) input/output modules provide the interface between a 5V microprocessor control system and external (controlled) 240 VAC industrial peripheral equipment.



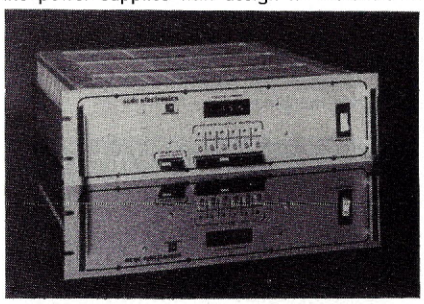
The I/O devices have optical coupling between input and output to provide a minimum of 3750 VAC isolation.

Price is $11 for singles, $9.40 for 100 up. For more information contact Motorola Subsystems, P.O. Box 29023, Phoenix, AZ 85038.

**CIRCLE INQUIRY NO. 154**

### Power Supply Design Kit

ACDC Electronics has a series of rack-mounted power supply systems in standard RETMA configurations. A simple do-it-yourself design kit allows the engineer to select the features desired; layout the power supplies with design kit materials to



suit his particular application; and determine the entire system's cost. The rack systems are delivered completely assembled, wired and tested with power supplies installed.

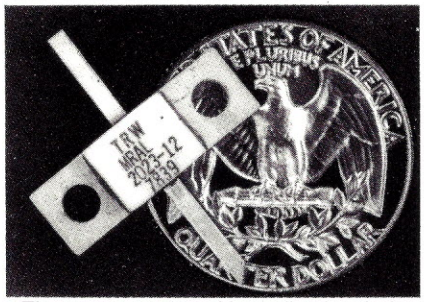
For more information or a free design kit, contact ACDC Electronics, 401 Jones Rd., Oceanside, CA 92054.

**CIRCLE INQUIRY NO. 155**

## COMPONENTS

### Broadband Transistors

The MRAL-2023 series broadband, high-gain transistors is a family of four devices engineered for military and industrial applications requiring power output ratings of up to 12W.



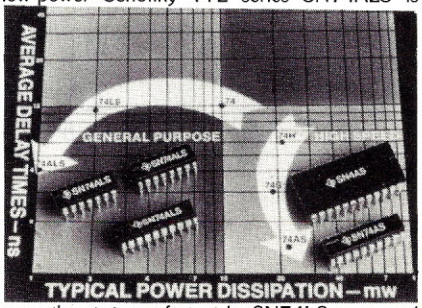

The transistors are gold metallized and glass passivated. They are internally matched for broadband capability by TRS's patented MICro AMP technique.

Prices range from $38.25 to $169.79 in 100 quantities. For details contact TRS RF Semiconductors, 14520 Aviation Blvd., Lawndale, CA 90260, (213) 679-4561, Mike Gagnon.

**CIRCLE INQUIRY NO. 156**

### Third Generation TTL Series

TI's high-speed advanced Schottky TTL series SN74AS is twice as fast as the SN74S series while maintaining virtually the same power dissipation per gate. The new general purpose advanced low-power Schottky TTL series SN74ALS is



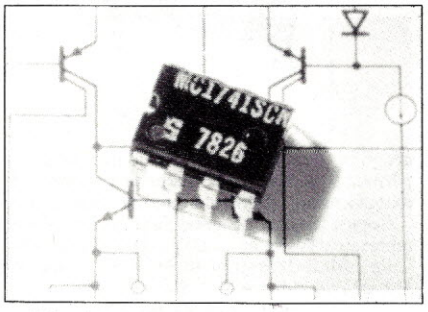

more than twice as fast as the SN74LS series and consumes half the power per gate.

Samples will be available first quarter 1979; production scheduled for second half 1979. For details contact Texas Instruments Inc., IAS, P.O. Box 225012, M/S 308 (Attn: SN74ALS/AS), Dallas, TX 75265.

**CIRCLE INQUIRY NO. 157**

## Operational Amplifier Series

Signetics has announced that it will second source the MC1741S operational amplifier. The new generation product features a guaranteed unity gain slew rate of 10 volts/microsecond, typically 15 volts.



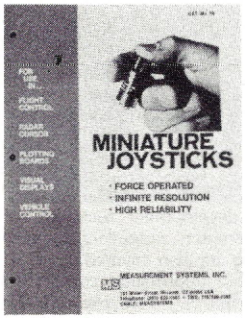
Other features include short circuit protection, offset null capability, large common mode and differential voltage ranges, and internal frequency compensation.

Prices start at $.98 in 100s. For details contact Signetics, 811 E. Arques Ave., Sunnyvale, CA 94086, (408) 739-7700, Guy Caputo.

**CIRCLE INQUIRY NO. 158**

## Miniature Joysticks

These joysticks are widely used for cursor positioning of many displays including interactive terminals, computer aided drafting, and radar systems.



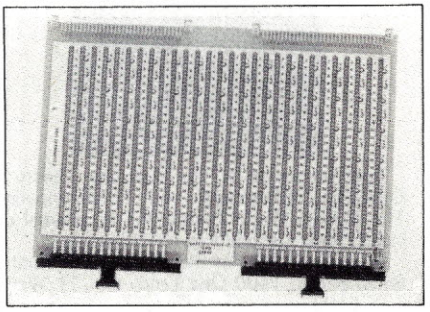

They are also used for mechanism positioning such as micro circuit production equipment and vehicle control. These joysticks are offered for control of 1, 2 or 3 axes in three grades suitable for commercial, industrial and military.

For details contact Measurement Systems, Inc., 121 Water St., Norwalk, CT 06854.

**CIRCLE INQUIRY NO. 159**

## Metric Series Wire-Wrap Boards

A new series of metric wire-wrap packaging panels feature multi-layer Schottky TTL construction. The new series offers a 160mm x 233mm board with an I/O area compatible with the European right-angle wire-wrappable, dual 96-position connectors.



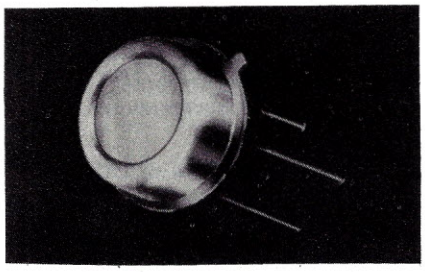
The Schottky TTL construction provides two outside ground plane layers with a sandwiched Vcc plane for low-impedance power distribution.

Prices range from $150 to $350 per board. Delivery is 4-6 weeks. For more information contact Garry Manufacturing Co., 1010 Jersey Ave., New Brunswick, NJ 08902, (201) 545-2424, Harry Koppel.

**CIRCLE INQUIRY NO. 160**

## Pyroelectric IR Detector

Model 400 pyroelectric IR detector is a low-cost, high quality device. An external impedance converting circuit, consisting of a JFET and a high megohm bias resistor is required to lower the inherent high impedance of the sensor.



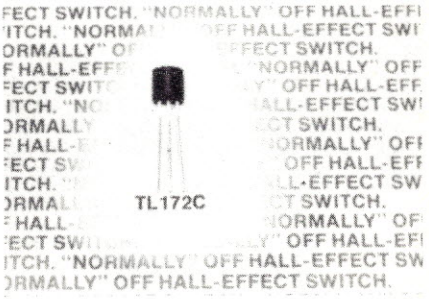
The detector consists of a sensing element, mounted on a TO-5 header and protected by a transistor housing with window. The sensing element is a thin wafer of Lithium Tantalate, with an active sensing area 2mm diameter.

Price is $15 in 100s. For more information contact Eltec Instruments, Inc., P.O. Box 9610, Daytona Beach, FL 32020, (904) 252-0411.

**CIRCLE INQUIRY NO. 161**

## Hall-Effect Switch IC

A new "normally-off" silicon Hall-effect switch — the TL172C — is a low-cost solid-state switch that uses the Hall-effect to sense the presence of a magnetic field.




Each circuit comprises a Hall-effect sensor, signal conditioning and hysteresis functions, and an output transistor — all integrated into a monolithic silicon chip.

The TL172CLP 100-piece price is $.43 each. For more information contact Texas Instruments, Inc., IAS, P.O. Box 225012 (Attn: TL172C), MS-308, Dallas, TX 75265.

**CIRCLE INQUIRY NO. 162**

## Optical Transceiver IC

The CS-258 optical transceiver is an LSI integrated circuit using linear $I^2L$ technology to combine power, low noise and digital circuits. It is designed for use as an intrusion alarm, proximity detector or small particle sensor in security, industrial or environmental applications.

Features of the new unit include strobed detection for high ambient light operation plus combined analog and digital noise filter to eliminate false triggering.

Prices start at $2.24 in 10,000 lots. For more details contact Cherry Semiconductor Corp., 99 Bald Hill Rd., Cranston, RI 02920, (401) 463-6000.

**CIRCLE INQUIRY NO. 163**


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- DFD* PROGRAM SPECIFICATIONS

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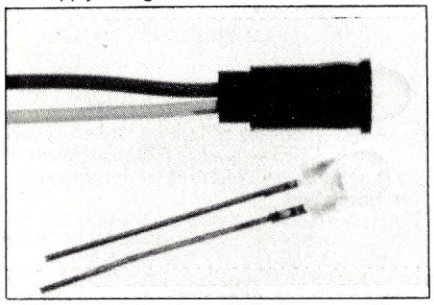
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### Two-Color LED Indicators

A pair of new two-color LED indicator lights is available from Industrial Devices, Inc. These indicators, which incorporate two LED chips connected in reverse parallel, provide either red or green light output depending on the polarity of the supply voltage.



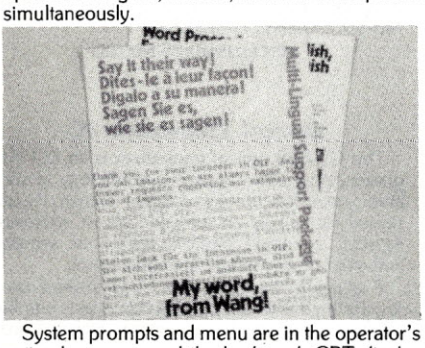
Price in 1000 lots start at $.87 each. Delivery is off-the-shelf through IDI authorized distributors nationwide. For more information and samples contact Industrial Devices, Inc., Edgewater, NJ 07020, (201) 224-4700.

**CIRCLE INQUIRY NO. 164**

## LITERATURE

### Multi-Lingual Support Package

A one-page flyer on Wang's *Multi-Lingual Support Package* is offered by Wang Laboratories. The Multi-Lingual option, for use on all Wang word processing systems, allows the user to operate in English, French, German and Spanish simultaneously.




System prompts and menu are in the operator's native language, and the keyboard, CRT display and printer are designed to include foreign language accents and special characters.

For more information contact Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851, (617) 851-4111.

**CIRCLE INQUIRY NO. 165**

### Relay Selection Guide

A guide detailing recommended relays for various loads such as single phase and three phase motors, heaters, transformers, solenoid valves, incandescent lamps, and contactor coils is available from Opto 22.

This shows detailed application information for the above type loads from 100 watts to 6KW. Various fuses for protecting solid state relays are also specified.

For more information contact Opto 22, 5842 Research Dr., Huntington Beach, CA 92649, (714) 892-3313.

**CIRCLE INQUIRY NO. 166**

### Display Terminal Product Sheet

A new product sheet that provides detailed specifications of the *concept APL,* an APL display terminal from Human Designed Systems, Inc., is available at no charge from the company.

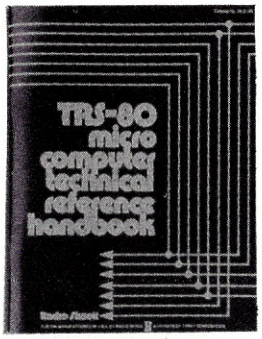
In addition to specifications of the display and keyboard (with artwork illustrating the keyboard format), the terminal's standard functions, operating modes and options are spelled out.

For a copy or more information contact Human Designed Systems, Inc., 3700 Market St., Philadelphia, PA 19104, (215) 382-5000.

**CIRCLE INQUIRY NO. 167**

### Technical Reference Handbook

Radio Shack has published a technical reference handbook for their TRS-80 Microcomputer System. The illustrated, 108-page book is intended primarily for technically oriented persons with a good working knowledge of digital logic circuits.




Topics covered in the book are Theory of Operation, Adjustments and Troubleshooting, The Outside World (connection to external devices), Parts List and fold-out Schematics.

Price is $9.95. For more information contact Radio Shack, 1400 One Tandy Ctr., Ft. Worth, TX 76102.

**CIRCLE INQUIRY NO. 168**

### Control Logic Product Summary

A new Product Summary from Control Logic, Inc., covers a comprehensive line of industrial microcomputers and interface modules specifically designed for use in industrial and process control applications.

In addition, the new Product Summary describes the company's microcomputer boards, development systems and just-introduced line of CINCH™ Intelligent Data Acquisition and Control systems. The latter are standalone microcomputer based systems which provide for both analog and digital I/O as well as an RS-232C communications interface.

Copies are available on request from Control Logic, Inc., Nine Tech Circle, Natick, MA 01760, (617) 655-1170, or from any of their representatives throughout the USA.

**CIRCLE INQUIRY NO. 169**

### Brochure Describes OIS/140

Wang Laboratories' new Office Information System (OIS)/140, available in three models with different storage capacities, is described in a one-page brochure.

OIS/140 accommodates up to 32 devices, from workstations to intelligent printers, telecommunications and typesetters, for exceptional versatility. Math, sort and security features are standard, and an optional 5MB disk speeds and simplifies archive filing.

For back-up or still larger archive capacity, OIS/140 will operate with an additional disk equivalent in size to the master.

For a copy or more information contact Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851, (617) 851-4111.

**CIRCLE INQUIRY NO. 170**

### Radio-Clock Circuits Brochure

OKI Semiconductor has available a free brochure describing the company's line of integrated circuits for use in digital clock and digital radio designs.

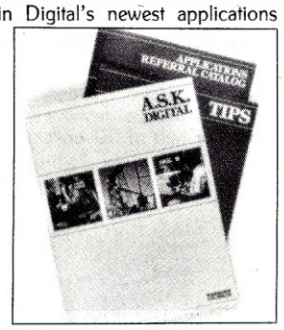
The new brochure briefly describes OKI's automobile clock, radio frequency counter, alarm clock, alarm clock and radio frequency counter, and radio synthesizer and display system circuits. Information on IC package types, availability, and various circuit applications is included.

For a free copy contact OKI Semiconductor, 1333 Lawrence Expwy., Santa Clara, CA 95051, (408) 984-4840.

**CIRCLE INQUIRY NO. 171**

### A.S.K. Digital

"A.S.K. Digital" is an applications software kit assembled by the Manufacturing, Distribution and Control products group of Digital Equipment Corporation. The kit contains materials for participation in Digital's newest applications referral



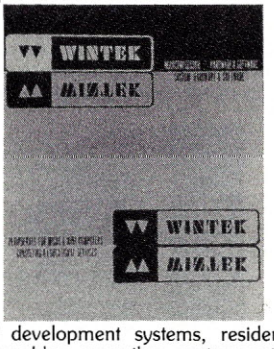

program, designed to help customers locate applications software and expertise suitable for manufacturing, distribution and process control.

Copies may be obtained through Digital sales representatives or by writing to Digital Equipment Corp., ML5-2/M46, 146 Main ST., Maynard, MA 01754, Attn: A.S.K. Central Desk.

**CIRCLE INQUIRY NO. 172**

### Microprocessor Hardware/Software/ Services Literature

Wintek Corporation has new literature available on 6800 based single board computer plus 15 support and interface modules on industry standard 4½" x 6½" cards for process control and data acquisition.




6800 development systems, resident and cross assemblers, compilers, custom systems and consulting are also covered.

For more information contact Wintek Corp., 902 N. 9th St., Lafayette, IN 47904, (317) 742-6802.

**CIRCLE INQUIRY NO. 173**

### ICP Expands Software Directory

The ICP Software Directory is undergoing a major expansion. Containing over 5500 software product descriptions, the directory has been published by International Computer Programs, Inc. for the past 12 years.

ICP has expanded the directory to a new total of five volumes, each published twice a year.

The split, from the present three volumes to five volumes will make it even easier for software buyers to locate information on specific products.

All volumes are available on a yearly subscription basis; purchase entitles the subscriber to the most recent published volume of his choice plus the next updated version of that volume. The annual subscription is $65 per volume with a 20% discount on subscriptions for more than one volume.

For more information contact International Computer Programs, Inc., 9000 Keystone Crossing, Indianapolis, IN 46240.

**CIRCLE INQUIRY NO. 174**

### Systems Analysis Guide Revised

Prentice-Hall has issued the Second Edition of *The Systems Analysis Workbook: A Complete Guide to Project Implementation and Control,* by Robert D. Carlsen and James A. Lewis. The book is a guide to analyzing faults in existing systems and designing new, improved ones.

# MANAGE

## NATURAL LANGUAGE DATA BASE MANAGER FOR THE ALPHA MICRO SYSTEM

Allows processing of files by sentences written in English, rather than by programs written in a computer language. For example, you may ask the computer to "List prospects whose interest is houses and whose price is between $60,000 and $90,000 by Zip Code as labels".

Definitional capability allows easy categorization of records into terms meaningful to the user. For example, telling the computer "DEF: Pasadena Residents: Mailing whose Zip Code is between 91101 and 91108 but not 91102" would allow subsequent processing using only the words "Pasadena Residents" to refer to that group. User defined terms are unlimited in form, length and number.

Help messages are available throughout the system for user convenience. By simply entering a question mark, at any time, the system will respond with a message specifying the type of input MANAGE is expecting. Dual question marks will print the message in greater detail. Triple question marks will display a complete, menu driven user's manual.

Other special features include: user defined, unlimited length fields; access from user programs via command files; passwords; background processing; and flexible output formatting.

A new approach to memory management optimizes the mapping of data, and the loading of programs, for maximum operating speed in the amount of memory available in the user's system. This is done automatically, and is transparent to the user. Thus thousands of records can be stored, ordered, categorized and otherwise processed in a matter of seconds, rather than in minutes or hours. Practical applications include:

| | |
|---|---|
| Mailing lists | Real Estate listings |
| Market analysis | Quality Control Records |
| Inventory files | Telephone directory |
| Personnel files | Reservation system |
| Customer listing | Mail order management |
| Buyer's Guide | Library cross indexing |
| Budget Analysis | Appointment scheduling |
| Price lists | Employment agency files |

A ready-to-use disk, with complete user's manual, is priced at $1250. A demonstration disk, with a maximum capacity of 90 records, is available for $100. Manual only, $5.00. Enhanced versions, as they become available, will be available to all users for a copying charge of $25.00, including revised manual.

The Byte Shop of Lawndale offers complete, turn-key systems with Video terminal, High speed printer, 48K memory, and a 10 Megabyte hard disk drive at prices starting at $15,750.

# BYTE SHOP OF LAWNDALE

16508 HAWTHORNE BLVD., LAWNDALE, CA. 90260 • PHONE (213) 371-2421

HOURS: TUE.-FRI. 10-7, SAT. 10-6, CLOSED SUN. & MON. WE'RE 3 MILES SOUTH OF THE L.A. INTL. AIRPORT, 3 BLOCKS SOUTH OF SAN DIEGO FWY.

# TRS-80

## RADIO SHACK COMPUTER Memory Expansion Kits

(Eight 16-Kilobit Chips)

## $79

Each Kit consists of: 8 Memory Chips, Jumper Blocks, and Complete EASY TO FOLLOW Instructions. Expands 4K TRS-80 up to 48K (3 sets)

SPECIAL:
**TRS-80FLOPPY Disk (SA-400) Add On COMPLETE Ready to use with power supply and case $389**

## ADD to your APPLE or S100 Bus Computer

**$79 — Set of 8 250 NS**
**$89 — Set of 8 200 NS**

## S100 BUS EXPANDORAM KITS*

Complete Kit Prices
(Chips, Board, Sockets, Manual, etc.)
**No. 4116 - 200 NS (w/16K Chips), 16K, $239; 32K, $325; 48K, $410; 64K, $495**
**No. 4115 (w/8K Chips), $189; 16K, $229; 24K, $269; 32K, $309**

**ASSEMBLED, TESTED AND BURNED IN - ADD $75**
*Expand NOW or LATER to 64K (32K for 8K Chips) 8K Chips: $40/Set of 8
28-Pin Sockets; 7-Digit, 7-Segment Displays; Photo Cells; Your Choice, 8 Per $1.00

**NEW MICRO COMPUTER INSTRUMENT**
Sensational new electronic invention functions as lie detector, ESP training aid, bio-feedback device, provides for direct communication with plants and the subconscious mind. The PSYCHE-TRON, featuring an internal microcomputer and ultra-sensitive detector, brings the power of micro-electronics technology to the challenge of electronic thought detection, yet is amazingly low-priced at $59.50 for this introductory offer only. Call or write for free details.

MONEY BACK GUARANTEE
FULLY WARRANTED FOR 6 MONTHS
Master Charge — VISA
C.O.D. (25% with order) — Money Order
California Residents add 6% Sales Tax
Shipping Charges: $2.00

## MicroComputer World

9649 London Ave., Temple City, CA 91780
P.O. Box 242, San Dimas, CA 91773
**(213) 286-2661**
**Call 24 Hours Toll Free: Opr 518**
**(800) 824-7888 (Nat'l) or (800) 852-7777 (Cal.)**

**CIRCLE INQUIRY NO. 82**


This Workbook is brimming with new forms, work sheets and checklists that answer qustions like: How much work can a system handle? How can critical bottlenecks be identified and measured?

Ideally suited for either manual or computer-related systems development projects, this fully-revised and expanded Workbook is an excellent tool for analyzing both simple and complex projects, and generating a uniform, integrated systems package.

Price is $29.95. Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.

**CIRCLE INQUIRY NO. 175**

### Mini/Micro Computer Supplies and Accessories Illustrated Price List

A new illustrated 12-page, 2-color price list listing hundreds of supplies and accessories for mini/microcomputers, computers, and word processing equipment, has been published by Printcraft Systems, Inc.

Featured are stock and low quantity customized continuous invoices, statements, checks, labels, letterheads and envelopes, self-mailers, etc.

Also listed are ribbons and printwheels for Qume, Diablo, IBM, DEC, Centronics and more.

Some of the accessories featured are diskette and cassette storage and retrieval systems, anti-static mats, and Halon fire extinguishers.

For more information contact Printcraft Systems, Inc., 11-17 Beach St., NY, NY 10013.

**CIRCLE INQUIRY NO. 176**

### New Misco Catalog

Misco Inc. is featuring Shugart Approved flexible disks and minidisks in the new Fall-Winter Misco Catalog.

The minidisks are designed and approved for use on the Shugart SA400 drive. Approved single density flexible disks, for Shugart SA800/801 and SA900/901/902 drives are available in both IBM and Shugart formats.

Shugart approval for the Verbatim™ flexible disks and minidisks is on file at Misco Inc.

For free catalog or more information contact Misco Inc., 963 Holmdel Keyport Rd., Holmdel, NJ 07733, (201) 946-3500.

**CIRCLE INQUIRY NO. 177**

### Remote Computing Service vs. Small Business Computing

When evaluating RCS versus other modes of data processing, many prospective users fail to consider the "total" costs of in-house systems.

A publication entitled "A Guide To Planning, Selecting and Managing Remote Computing Services" draws upon a series of surveys among DP'ers in concluding that the inherent cost advantages of RCS are too often overlooked.

While the Evans Guide is careful to admit that certain applications are more suited to in-house systems, it also gives the prospective user a set of procedures that allow an intelligent choice to be made. The guide presents a step-by-step approach to the procurement process, including statement of the problem, definition of objectives, conducting load profiles, prescreening RCS vendors, benchmarking, preparation and evaluation of proposals, negotiation of the RCS contract, and managing the service for his end-users.

For a detailed summary or more information contact Evans Research Corp., 1394 Palisade Ave., Fort Lee, NJ 07024.

**CIRCLE INQUIRY NO. 178**

### Product Selector Guide

A new Product Selector Guide aids in choosing from a wide range of miniature DC motors, gearheads, motor tachometers and optical velocity encoders to suite specialized applications.

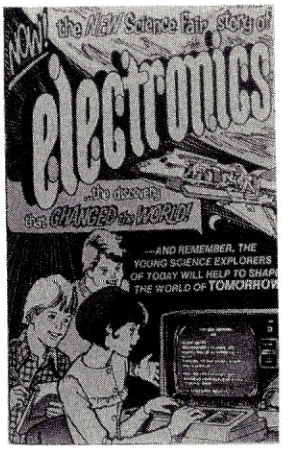
The new fully illustrated guide is designed as a quick reference source of all necessary information about the Micro-Mo product line, including electrical and mechanical characteristics plus dimensional outlines.

For a free copy contact Micro-Mo Electronics, 3691 Lee Rd., Cleveland, OH 44120, Ben Smith.

**CIRCLE INQUIRY NO. 180**

### Science Fair® Story of Electronics

An all-new and updated edition of Radio Shack's popular educational comic book, "The New Science Fair Story of Electronics. . .the Discovery that Changed the World!", is now available for free distribution to schools, clubs, youth groups and interested individuals.




The 24-page, full color booklet traces the development of electronics from ancient times to the present. Important discoveries and the people who made them are described in the easy-to-read narrative.

Free copies available from participating Radio Shack stores and dealers nationwide. Radio Shack, 1400 One Tandy Center, Ft. Worth, TX 76102.

**CIRCLE INQUIRY NO. 179**

### TRS-80 Software Source

ComputerMat has a new publication listing computer programs for Radio Shack's TRS-80 computers. The TRS-80 Software Source is now available and lists over 125 sources of software.

The listings include the supplier's name, address, phone, program catalog number, level of BASIC required, memory required, program description and the price for each program. The TRS-80 Software Source has programs listed and grouped alphabetically by supplier, classification and media source (cassette or disk).

The TRS-80 Software Source is published three times a year in January, May and September. Subscription price is $10 per year (3 issues) or $3.95 per issue. For more information contact ComputerMat, Box 1664, Lake Havasu City, AZ 86403, (602) 855-3357.

**CIRCLE INQUIRY NO. 181**

## SOFTWARE

### WORD for Alpha Micro

The system, for the Alpha Microsystems AM-100 16-bit microcomputer, consists primarily of an advanced line-oriented text editor ("SEX"™) and a powerful text processor ("WORD"), which together can easily handle any word processing application from letter-writing to the production of documents with extremely complex formats.

WORD converts any text file (created by SEX or otherwise) into a formatted output file by executing commands embedded in the text. Such functions as justification, centering, page numbering, and the like are supported, as well as more sophisticated features such as merging files, accepting operator input into a document being formatted, and creating a table of contents.

For information contact Dravac Ltd., 13 E. 30th St., NY, NY 10016, (212) 889-1556.

**CIRCLE INQUIRY NO. 182**

### PASCAL for North Star Horizon

North Star Computers, Inc. has announced that PASCAL is now available for use with the North Star Horizon computer and Micro Disk System.

North Star PASCAL is a "super-language" that permits demanding programming tasks to be completed faster and with less effort than is possible with languages such as FORTRAN or assembly language. That speed is possible because PASCAL promotes the breaking up of large tasks into smaller, more manageable subtasks — known in PASCAL as "procedures" or "functions."

The North Star PASCAL package includes its own operating system. PASCAL programs are compiled into fast-executing "P-code" and are executed at runtime by a program which simulates the operation of a hypothetical computer called the "P-machine."

The primary North Star PASCAL package is available from stock to owners of Horizon computers or Micro Disk Systems for $49. The system documentation package alone may be purchased separately at $20 per unit. For more information contact North Star Computers, 2547 9th St., Berkeley, CA 94710.

**CIRCLE INQUIRY NO. 183**

### Contract Management System—CM-I

Here is a real money saver for residential and commercial contractors. Utilizing Vector Graphic hardware and Digital Microcomputer Systems' software we can announce CM-I, a contractor's dream.

CM-I keeps track of all the little expenses that eat up your profit. In addition you can get a monthly breakdown of your disbursements by job and payee.

CM-I is available in a small system and completely upgradeable as you grow. Price is $5995 including a printer for paper copy.

To order or for more information contact Digital Microcomputer Systems, 927 Blanding Blvd., # 4, Orange Park, FL 32073, (904) 269-2002.

**CIRCLE INQUIRY NO. 184**

### Software for Small Businessman

For the small businessman trying to get his accounting functions running on a computer, Professional Systems Development has written the Accounting Software Application Package (ASAP).

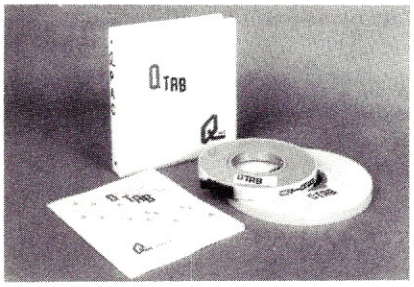
The documentation is of the caliber furnished with large mainframe software costing tens of thousands of dollars. ASAP has seven subsystems applicable to the general accounting practices of most small businesses: General Ledger, Accounts Receivable, Accounts Payable, Inventory Control, Payroll, Cash Receipts, and Cash Disbursements.

Price is approximately $400, available only through qualified computer dealers. Dealer inquiries should be directed to Professional Systems Development, Inc., 2555 E. Chapman Ave., Suite 411, Fullerton, CA 92631, Attn: James L. Dunn, Sales Manager.

**CIRCLE INQUIRY NO. 185**

### Payroll/Personnal Report Writer

The QTAB is a user-oriented report writer that enhances a worldwide payroll personnel and labor costing costing software system. The software program lets users with little or no data processing experience automatically generate pay-




roll, personnel, and labor costing reports with any desired format or data precedence. A user-expandable data dictionary permits catalogued report formats to be called up and reports to be written without reference to specific data files.

For more information contact QPAC of America, Inc., 1 Perimeter Rd., Grenier Field, Manchester, NH 03103, (603) 669-2355, Dan Skibba, Senior Consultant.

**CIRCLE INQUIRY NO. 186**

### Super-Sort Mail-List

The Super-Sort Mail-List and Lookup System (SMLS) name and address system can make any computer running with CP/M and CBASIC run like a large computer mailing system. The system is user-oriented with instructions every step of the way. Features of the system are completely interactive entry of:

1. Attention of
2. Company name
3. Street address
4. Room number
5. City
6. State
7. Zip Code — up to 10 digits. Even Canadian zip codes may be used.
8. Area code and telephone number
9. Selection category guide — to enable you to select qualifying information you specify.

Available on North Star mini-floppy diskette. For more information contact H S C Computer Services, Ltd., Brooklyn, NY 11236.

**CIRCLE INQUIRY NO. 187**

### Project Control System Software

Ideally suited to the construction industry and large manufacturing projects, READINET represents a unique combination of interactive computing techniques with classical PERT/CPM Time, Cost and Resource calculations.

The blend results in an instantly usable, conversational project control system. All interaction is via a CRT terminal, with printed reports and analysis available on command.


# TRS-80
# PERIPHERALS & SUPPLIES

**DISK DRIVES $399.00**

**Fully compatible** with Radio Shack drives. **Includes:** ■Power supply ■ case (specify silver or blue) ■4 drive connector cable ■ verbatim diskette with test program and user op. system ■ 60 day warranty ■ complete user instructions.

**16K RAM SETS $106.00**

**200NS 16K Dynamic RAM Memory Kit.** NEC chips. Includes jumpers and instructions for installing in TRS-80 keyboard unit or expansion interface. (Specify keyboard or interface.)

**VERBATIM DISKETTES $3.30 ea. 10 FOR $30.00**

**These are the top of the line** in diskettes and worth every cent of the $6.00 each that you pay elsewhere.

**CENTRONICS-779 LINE PRINTER $1200.00**

**With forms tractor.** This is the same printer that Radio Shack supplies. A 399.00 savings if you buy from us.

**TI-810 PRINTER $1995.00**

All set to run on your TRS-80 at twice the speed of the 779.

**Send to P.P.S.**
P.O. Box 2051, Seal Beach, California 90740

**For fast service** or information call (714) 894-3736

**CIRCLE INQUIRY NO. 87**

# Personal Computing... It All Comes Together at NCC '79.



Only during the National Computer Conference will you have an opportunity to experience personal computing to the fullest. And that's why the 1979 Personal Computing Festival, June 4-7 in New York's Sheraton Center Hotel, formerly the Americana, is different. As a conference within a conference, it will give you the chance to explore the complete spectrum of information processing while concentrating on those aspects of personal computing you won't want to miss...including equipment, applications, ideas, and new developments that have created excitement throughout the entire computing community.

Only at NCC '79 will you find such a panorama of computer products on display...ranging from micros to maxis, from processors to peripherals. Included will be the latest innovations in low-cost computing for business, professional, and home use.

Against the backdrop of the prestigious NCC, the Personal Computing Festival has attracted many well-known experts and personalities who will participate in an information-packed technical program and compete for prizes for the best presentations. Join them in exploring applications ranging from use of small business systems and financial analysis to personal networking, new information utilities, and aid to the handicapped.

You will also have ample opportunity to discuss new ideas and novel approaches to shared problems, to find out what to expect in the year ahead, and observe interesting and clever applications demonstrated by the individuals who developed them.

Plan now to take part in a unique personal computing experience at NCC '79. You can register for the Festival at the Sheraton Center Hotel, 52nd Street between 7th Avenue and Avenue of the Americas, for only $15 which includes your copy of the **NCC '79 Personal Computing Proceedings.** Registrations, excluding the **Proceedings,** also are available at $5 for one day and $9 for all four days. The **Proceedings** will be available separately at $8. For additional information on NCC '79, including housing and registration procedures, contact AFIPS, 210 Summit Avenue, Montvale, N.J. 07645; telephone 201/391-9810. To obtain information on the special NCC Travel Service call toll-free 800/556-6882.

**NCC '79**
**PERSONAL COMPUTING FESTIVAL**
**c/o AFIPS, 210 Summit Avenue, Montvale, N.J. 07645**

Up to 16 different resource types may be associated with each activity. Each resource type can have its own unit cost. Also, each activity can be assigned a non-resource linked cost to cover materials, plant hire, rentals, etc.

READINET is written in Business BASIC under the IRIS Operating Sytem and utilizes random access file structures. It can automatically create and delete its files as required.

The price for the basic READINET is $2,900. Delivery is 30 days ARO. For more information contact Educational Data Systems, 1682 Langley Ave., Irvine, CA 92714, (714) 556-4242.

**CIRCLE INQUIRY NO. 188**

### Micropolis Software

Small Business Computer Services has a new business and consumer line software packages for the Micropolis Mod II Disk System.

The consumer line consists of the Investment Pack which contains many programs covering the full range of investments. Another in the consumer line is the Family Pack. This package serves as a gap between the hobbyist and the strictly business programs.

The Investment and Family packages are $35 each or $60 for both.

The business line of software consists of a complete Accounts Receivable system which also provides complete cash receipts journal, aged accounts receivable report, total sales report complete with breakdowns of taxes, freight, non-taxable sales and taxable sales.

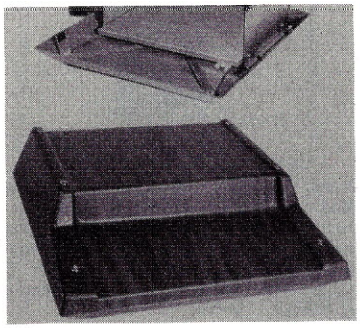
Price for Accounts Receivable or an Accounts Payable package is $150 or both for $250. For details contact Small Business Computer Services, 813 MacArthur Dr., Urbana, IL 61801.

**CIRCLE INQUIRY NO. 189**

## MISCELLANEOUS

### Micro Case

The Computer Enclosure CE-18 is a low-cost, good looking microprocessor case for single



board or multi-card systems that need protection or when enhanced display is desired.

The contour-formed Royalite unit provides for effortless mounting with its easily modified chassis — for connector mounted multi-card or single card systems. The keyboard can be either self-supported or mounted on stand-offs.

Standard color it walnut woodgrain. Price is $54.95. For more information contact JRF-Tronics, Inc., 1061 N. Shepard, Unit D, Anaheim, CA 92806, (714) 630-0600, Daniel Henrich.

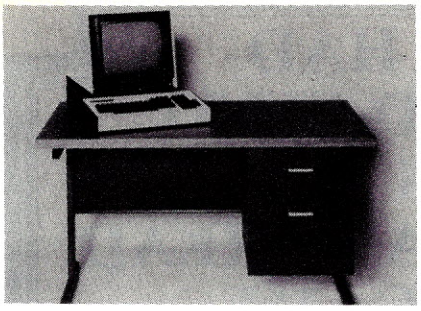
**CIRCLE INQUIRY NO. 190**

### Pedestal Terminal Desk

The ESF terminal desk is a contemporary-styled pedestal terminal desk designed with the stability needed for data processing equipment. The standard unit measures 48" wide, 30" deep and 26" high.

Other widths include 26, 36, 60 or 72 inches. Depth maybe standard 30" or 26 or 32 inches. Heights include 26, 28 and 36 inches.

Options include locking chrome ball casters, returns, 3 shelves instead of standard 2 drawers, cutouts to accommodate cables and a keyboard recess in the top. Normal delivery is three weeks.



For more information and prices contact Electronic Systems Furniture Co., 1215 E. El Segundo Blvd., El Segundo, CA 90245.

**CIRCLE INQUIRY NO. 191**

### Computer-Powered Headhunting

Datamatics Management Services, Inc., has developed a complete turnkey system particularly designed to meet the needs of personnel agencies and consulting firms.

Consisting of two software packages, SEQ — The Search Employee Qualificatins Personnel System, and PSSST — The Professional Staff Skill Scheduling Technique, the system provides for the storage and retrieval of pertinent information about both applicants and clients.

SEQ and PSSST are written in DATABU language and are currently running on a Datapoint computer. This complete Datapoint turnkey system is available for $16,000. For more information contact Datamatics Management Services, 140 Route 9W, Englewood Cliffs, NJ 07632, (201) 947-6100, Jackie Powers.

**CIRCLE INQUIRY NO. 192**





**MICROBYTE 32K 695.00**

FULLY STATIC — 450ns

☆ ☆ ☆

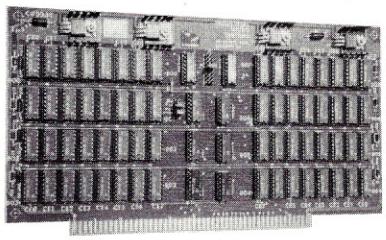
**Industrial Micro Systems**

| | Fast | Slow |
|---|---|---|
| **16K** | **439.00** | **395.00** |
| **32K** | **769.00** | **695.00** |

**Microbyte**

| | | |
|---|---|---|
| **16K** | **439.00** | **395.00** |
| **32K** | **769.00** | **695.00** |

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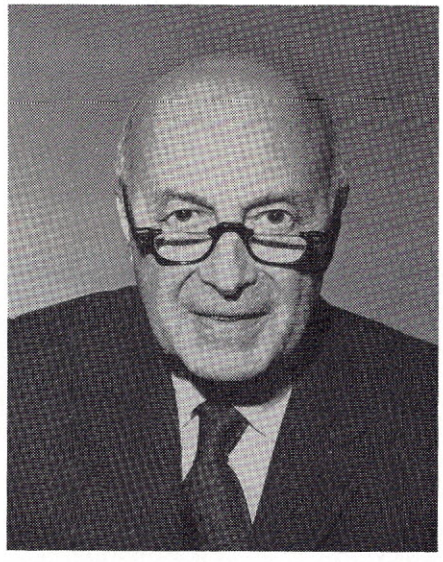
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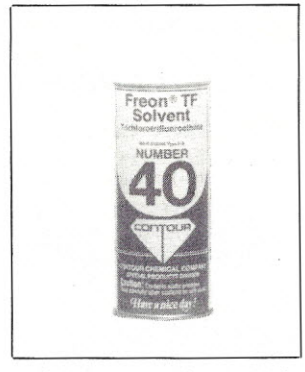
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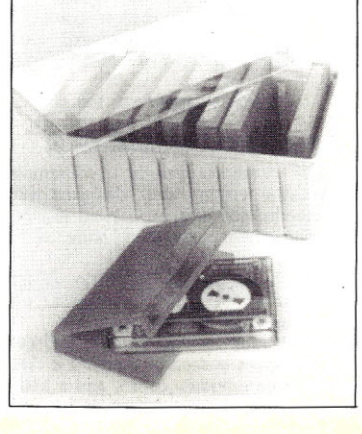

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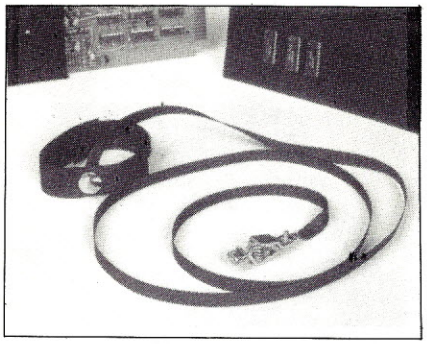
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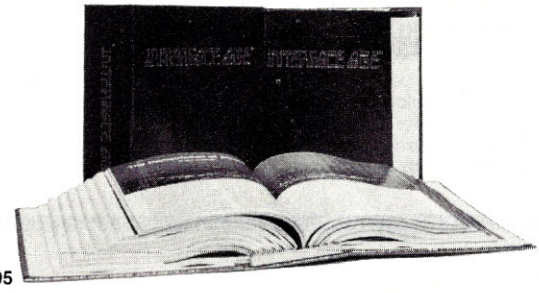
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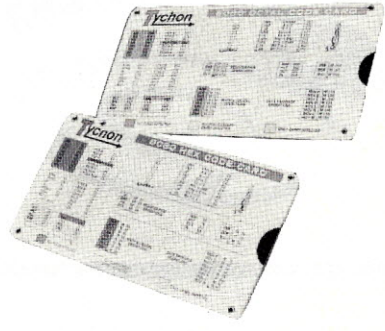
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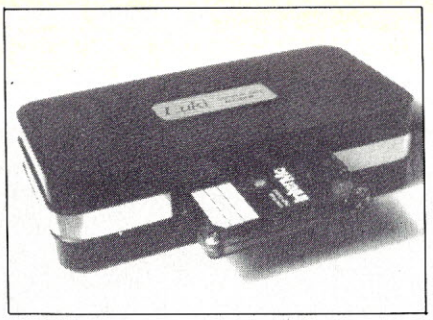
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# The KLH Spooler for CP/M

## INTRODUCTION

The 8080 microprocessor performs input and output operations with a pair of two-byte instructions:

```
DB11    IN      DATA    and
D311    OUT     DATA
```

These instructions contain the address of the peripheral in the second byte. Since there are 256 different 8-bit combinations, the 8080 can, in principle, communicate with 256 peripheral devices. But it is customary to utilize two ports (addresses) for each peripheral, one for the data itself, and the other for status information about the peripheral. Therefore, there is a practical upper limit of 128 separate peripherals (which still ought to be enough for most applications).

Not all peripherals use two ports, however. Computers with front panel switches, such as the MITS or IMSAI, assign the address FF HEX to these switches. A status port is unnecessary in this case since the switches are always ready to be read with the command:

```
        IN      OFFH
```

The PerSci intelligent disk controller uses two ports, but usually so-called dumb controllers made by Tarbell and S.D. Sales use 5 or 6 ports.

## OTHER PERIPHERALS

The standard ASR 33 Teletype prints at a speed of 110 baud (bits per second), which is equivalent to ten characters per second. More modern terminals such as the DECwriter and the Diablo printer operate at 300 to 1200 baud (30 to 120 characters per second). Faster yet are video terminals, which can run at 9600 or 19200 baud. All of these terminal speeds, however, are relatively slow when compared to the two megahertz (2 MHz) speed of the 8080.

A typical setup for a small business might be:

| | |
|---|---|
| Console | (keyboard and video display) |
| Line printer | (hard copy) |
| Magnetic tape | (for backup copies) |
| Floppy disks | (main operating system) |
| Telephone modem | (link to a large computer) |

Each of these peripherals will have its own software routines to effect an orderly transfer of data between the computer and itself. For example, if a file is to be printed on the list device (line printer), the computer first checks to see if the device is busy (i.e., hasn't printed the last character that was sent).

```
LWAIT:  IN      LSTAT   ;READ LIST STATUS
        ANI     LMASK   ;MASK UNWANTED BITS
        JZ      LWAIT   ;LOOP UNTIL READY
```

Since the computer is able to send data to the terminal much faster than it can be printed, the above routine will, in effect, slow the computer down to the peripheral speed. Thus, during output, the computer may spend over 99% of its time looping around these three instructions. When the list device has finally printed its character, the output-ready bit is changed and the computer sends another byte:

```
        MOV     A,C     ;GET THE BYTE
        OUT     LDATA   ;PRINT IT
        RET
```

and returns to its next task.

## INTERRUPTS OR POLLING?

There are two common ways to more effectively utilize a computer during relatively slow output. One method is to use the 8080 interrupt system. In this case, the 8080 sends a byte to a peripheral, then returns to another task. When the byte has been printed, the device signals the computer through an interrupt line. The computer stops what it is doing (is interrupted), saves the contents of its registers, and looks to see who called. In this case, it sends another byte to the printer, then returns to its previous work. With an interrupt system, the computer is not spending large amounts of time waiting for the printer.

Vectored-interrupt boards are available for the S-100 bus. These allow eight separate peripherals to interrupt the 8080 on a priority basis. Lower-priority peripherals can interrupt the 8080, but they can in turn be interrupted by higher-priority peripherals. Thus, if the line printer has interrupted the processor to request another byte, the system real-time clock on a higher-priority can interrupt this output when it needs to increment its time.

# Keeping Your Line Printer Busy

Review by Alan R. Miller, Contributing Editor

Since there appear to be problems with implementing this sophisticated system, another approach has been successfully used. This second method is to have the computer frequently poll the busy (status) routines for the peripherals. If a device is busy, the computer returns to its work instead of simply looping:

```
LBUSY:  IN      LSTAT   ;GET LIST STATUS
        ANI     MASK    ;CHECK ONE BIT
        RZ              ;RETURN IF NOT READY
```

The Westminster Byte Shop has incorporated this second technique into a time-sharing BASIC called Northshare. Up to four separate users can independently run BASIC programs on different terminals. (Northshare was reviewed in the November, 1978, issue of INTERFACE AGE.)

Lance Hultgren of KLH Systems has written a spooler routine for CP/M that also uses the polling technique. His program can intercept all output destined for the line printer, placing it into a disk file. Each time the list device prints a character, SPOOL sends another byte from the disk buffer. The result is that the line printer is outputting at its full speed (relatively slow) most of the time, while the user is doing other things at the console.

## THE CP/M OPERATING SYSTEM

The CP/M disk-operating system was reviewed in the July and December issues of INTERFACE AGE. The user initially writes the interface software (called BIOS) that CP/M needs for communication with the peripherals (console, list, floppy disks, etc.). CP/M itself doesn't contain any peripheral routines, but utilizes instead those written by the user. Thus, a CP/M version of a BASIC interpreter will run on an Altair that is connected to a DECwriter and an 8-inch floppy disk as well as an IMSAI attached to a Teletype and a 5-inch minifloppy. The CP/M operating system is not concerned that the 8-inch disk may be formatted as 77 tracks, with 26 sectors per track and 128 bytes per sector, and that the 5-inch disk has 35 tracks with 10 sectors per track and 256 bytes per sector.

## SPOOLER LIMITATIONS

At this time, the KLH spooler program, unlike the usual CP/M programs, actually alters the CP/M BIOS routines and expects the disk format to be the standard 8-inch, 77-track version. Thus, spooler will not work with any 5-inch disk, or double-sided, or dual-density 8-inch disks. A PerSci model 70 or 277 drive (or the equivalent) must be used for this program.

## THE CP/M IOBYTE

The CP/M system has been designed so that the user can assign each of the four logical devices:

CON: Console
LST: List output
PUN: Punch
RDR: Reader (tape input)

to any of four physical devices (for a total or 16 peripheral devices). The sixteen combinations are all encoded into a single byte at address 3 (termed the IOBYTE). The user, of course, has to implement the IOBYTE in BIOS. But once it has been written into BIOS, the CP/M program STAT.COM can be used to display the 16 possible combinations and the current configuration. Also, STAT can be used to change the current assignment of peripherals.

With a video terminal and a DECwriter, the logical console can be configured four ways:

| Input | Output |
|---|---|
| Video keyboard | Video screen |
| Video keyboard | DECwriter |
| DEC keyboard | Video screen |
| DEC keyboard | DECwriter |

corresponding to IOBYTE values of 0, 1, 2, and 3 respectively. Similarly, bits 4 and 5 of the IOBYTE can be used to send the logical list output to the DECwriter, a paper tape punch, a telephone modem, or to the video screen.

Spool reads the IOBYTE to find what physical device is currently assigned to the logical list output. To incorporate spool into CP/M, BIOS must be reassembled. At the beginning of BIOS, there is a set of jump instructions:

```
START:   JMP     BOOT
WBOOTE:  JMP     WBOOT
         JMP     CONST
         • •     • •
         • •     • •
         JMP     WRITE
         JMP     XTRA1     ;ADDED CUSTOM
         JMP     XTRA2     ; ROUTINES
```

At the end of the jump sequence, place an FF HEX, then the addresses of the list-busy routines for the four physical list devices:

```
         DB      OFFH      ;END OF JUMPS
         DW      LIST1     ;LIST BUSY ADDRESS
         DW      LIST2     ;PUNCH BUSY ADDRESS
         DW      LIST3     ;MODEM BUSY ADDRESS
         DW      LIST4     ;CONSOLE BUSY ADDRESS
```

The routines at these four addresses must be specifically one of the following two forms:

```
LOUT:    IN      LSTAT     ;GET STATUS
         ANI     MASK      ;MASK UNWANTED BITS
         JZ      LOUT      ;LOOP UNTIL READY
```

or

```
LOUT:    IN      LSTAT     ;GET STATUS
         ANI     MASK      ;MASK UNWANTED BITS
         JNZ     LOUT      ;LOOP UNTIL READY
```

If the IOBYTE feature hasn't been incorporated, then put the busy address for the list device into each of the four locations LIST1 through LIST4.

If necessary, the size of a CP/M may have to be reduced by reassembling BIOS to a lower memory location. This is because spooler relocates itself into the top 1-K bytes of contiguous memory, above CP/M. For example, if you are currently using a 40-K version of CP/M, change the BIOS statement:

```
MSIZE    EQU     40        ;MEMORY  SIZE
```

to

```
MSIZE    EQU     39        ;MEMORY  SIZE
```

CP/M itself will also have to be converted to the new memory size using the CPM.COM program:

```
CPM 39 *
```

Copy the new BIOS and CPM (and the cold-start loader) to the first two tracks of the diskette using SYSGEN. Then Perform a cold start to load the new BIOS.

## IMPLEMENTING SPOOLER

When spooler is implemented with the command:

```
A>SPOOL
```

the response is:

```
INITIALIZE      (I)
SUSPEND         (S)
RESTART         (R)
```

Type an upper-case I to initialize spooler. (Use upper case for all commands.) The next response is:

```
ENTER DISK DRIVE (A,B,C,D)
```

Respond with the drive which the spool buffer files are to be on. If using more than one drive, choose the one that will have the least activity. Finally, spooler will request:

```
ENTER NO. OF SPOOL FILES (1-6)
```

Spool will create up to 6 buffer files of 16-K bytes each. Choose the largest number that will fit on the diskette. If a file sent to the list device is bigger than the spool buffer, things will get held up until there is enough room in the buffer. Spool now configures itself above CP/M, alters the CP/M list routines, then returns the system to the CP/M command level.

## PRINTING A FILE THROUGH SPOOL

Since spool intercepts all output destined for the logical list device, there are several ways to utilize it. The simplest way is to type a Control-P. All console output will now also be sent to the spool file. It may appear at first that spool is not working, but that is because spool waits until a 128-byte block is filled before sending anything to the physical list device.

A disk file can be reprinted in using PIP. The command:

```
PIP LST:=BIOS.PRN[T8]
```

will list BIOS.PRN through spool. (The T8 argument expands tabs to 8-space columns.) As another example, the print file generated during assembly can be sent directly to spool with the proper argument on the assembler command:

```
ASM BIOS.AAX (type Control-P too)
```

or

```
MAC BIOS $PP
```

As soon as the file has been loaded into the spool buffer, CP/M returns to the command level:

```
A>
```

You can now, for example, run Microsoft BASIC (which will be reviewed in a forthcoming issue). Load an existing BASIC source file from disk (which will momentarily slow down the list device) or create a new one. Then the command LLIST will print the BASIC program through spooler. When running a program, its output can be sent to spooler with the commands:

```
20 LPRINT NAME(I), ADDR(I)
```

or

```
40 LPRINT USING A$; BALAN(J),PAYM(J)
```

## SUSPENDING SPOOLER

Spooler can be temporarily suspended, if CP/M is at the command level, by typing:.

```
SPOOL S
```

In this way output can be sent directly to the list device bypassing spool. Then the command:

```
SPOOL R
```

will restart spool. It should continue exactly from the point where it was suspended. If spooler is reinitialized with the I command, be sure to delete all existing spool files first with the command:

```
ERA *.SPL
```

All in all, SPOOL is a nice addition to the growing collection of CP/M programs. You can effectively keep your list device printing all the things you want a hard copy of, while you are doing more interesting things on your video terminal. A few more features will soon be added to spool. One will allow the user to define a control character such as Control-D to make it easier to use single-page printers. It will cause the list device to pause while another sheet of paper is put into the machine. A second new feature will allow the user to set the page length and emulate formfeeds. finally, we can soon expect to see a spooler version for the five-inch minifloppy disks.

Version 2.2 of SPOOL is currently available from KLH Systems, 18101 Carolyn Circle, Villa Park, CA 92667. The price is $70. SPOOL can also be obtained from Tarbell Electronics.□

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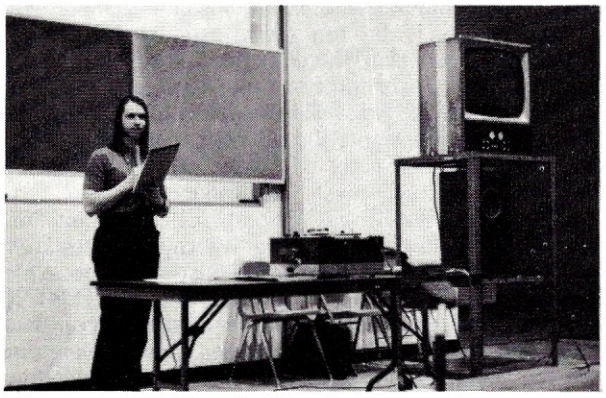
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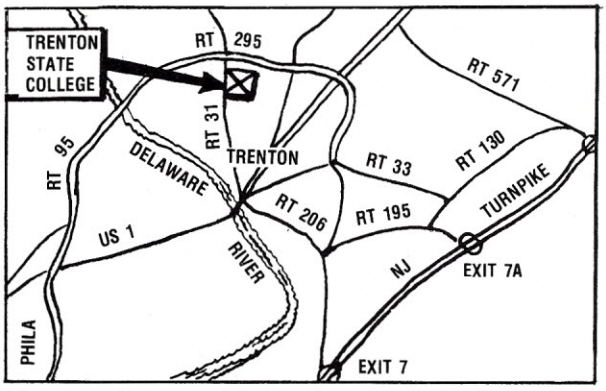
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# 6502 Comprehensive Memory Test Program

By Steve Nabers

## INTRODUCTION

A good memory diagnostic program should verify that every bit position of every byte can be accessed and modified independently. It should test specifically for the most likely errors in logic or wiring and, above all, it should simplify the process of diagnosing the fault — even at the expense of a longer test or series of tests. The comprehensive memory test described here fulfills all of these requirements for a 650X based system.

CMT was written for use on an MOS Technology KIM-1 system. With a few minor changes, it can be used with any system based on the 650X family. CMT consists of a monitor routine, which cycles through the selected tests, and seven individual test subroutines. The subroutine descriptions below give a brief account of the test, its specific purpose, and the approximate running time per K of memory tested (based on a 1 Mhz clock with no wait cycles).

## TEST SUBROUTINES

TEST0: all zeroes test. A test pattern of $00_X$ is written into and read from each byte under test. This test will fail if any bit is hung in a high state, if a memory chip is missing or not being selected properly, or if tri-state buffers are not being enabled at the right time. (0.05 seconds/K)

TEST1: all ones test. A test pattern of $FF_X$ is written into and read from each byte under test. This test will fail if any bit is being held low. (0.05 seconds/K)

TEST2: sliding one test. A test pattern of $01_X$ is written into and read from each byte under test. The pattern is then shifted left and the test repeated until eight passes have been made. This test will fail if any two adjacent data bits are tied together, perhaps by a solder bridge. (0.41 seconds/K)

TEST3: sliding zero test. A test pattern of $FE_X$ is written into and read from each byte under test. The pattern is then rotated left and the test repeated until eight passes have been made. This test will fail if any two data bits are tied together. (0.41 seconds/K)

TEST4: one-up counter test. A test pattern of $00_X$ is written into and read from each byte under test. The pattern is then incremented and the test repeated. When each data pattern has been tested in every byte, the test terminates. This test confirms that every pattern can be written in every byte. (13.1 seconds/K)

TEST5: address test. A pattern of $00_X$ is written in the byte indicated by the test address (initially set to the first address to be tested). A pattern of $FF_X$ is then written in the remainder of the test area, checking for interference with the location under test. The test address is then incremented and the test repeated. When all bytes in the test range have been checked for interference, the test terminates. This test will detect any problems in addressing, including address bits tied together. (70 seconds/K)

TEST6: random data test. This test fills the test range with a pseudo-random pattern, then checks that all bytes are correct. If your memory passes all other tests but flunks this one, you have probably encountered the early bane of the semiconductor memory industry: the pattern sensitive RAM. (0.14 seconds/K)

## SELECTING AND RUNNING THE TESTS

Location SADR and SADR+1 should be set to the low and high bytes of the first location to be tested. EADR and EADR+1 should be set to the last location to be tested plus one. The tests to be run are chosen by setting bits in SELECT. To run TEST0, set bit zero of SELECT to a one. To run TEST3, set bit three to a one. If bit seven of SELECT is zero, the selected tests will run once. If bit seven is one, the test monitor will execute the selected tests indefinitely. For example, if SELECT is set to $06_X$, TEST1 and TEST2 will be run once, and all other tests will be skipped.

After setting SADR, EADR and SELECT, start the test monitor at location $24_X$. Any error will cause the test monitor to return to the KIM monitor and display the address in error and the incorrect data. The user can examine TESTNO to discover which test failed, TSTBYT to see the correct data, and LOOPCT to see how many times the tests were run before the failure. If the single pass mode was selected, when all tests have been successfully completed, the test monitor returns to the KIM monitor and displays location 0.

It should be emphasized that your memory cannot be certified as perfect until it can pass all seven tests without failure. If only one test is to be run as a quick check, it should be TEST6. Running TEST6 for a few minutes will catch any addressing problem and most data bit errors. However, any errors that do show up may be hard to diagnose.

TEST5 takes by far the most time to run, but it is extremely useful in checking newly wired memory boards for solder bridges in the address lines and for checking that all bits are accessible. In attempting to debug TEST5, I discovered a failure in my memory which caused the two high order address bits to be tied together within the 2102 package itself. Therefore, these tests should be run whenever new components are installed in a system or existing ones are reconfigured. Running all seven tests periodically will insure that software bugs are not really memory problems in disguise.□

## Sample Table

```
IDENTIFIER  VALUE  LINE

BEGIN       0028   *29    54
EADR        0002   *11   198   200   216   219
FPRTN       0100    64    74    83    97   110  *177
FPRTN1      0105  *179   184
FPRTN2      0112   182  *185
INCRS       004D    33    42  *48
INCR        0113   133  *193
INCR1       011A   195  *197
INCR2       0128   199   201  *204
INCR3       0132   207  *209
INCTAD      0133   140   156   167   183  *212
INCTA1      0139   213  *215
INCTA2      0143   217  *220
INITAD      0144   126   149   158   178  *225
JSRADR      003D    *7    38    40
LOOPCT      0007   *15    28    52
MAIN        002A   *30    51
MASKS       000E   *19    32
POINTH      00FB    *5    46    57
POINTL      00FA    *4    44    56
POINT       000A   *17   128   130   136   193   196   197   204   205
RAND        014E   154   163  *237
SADR        0000   *10   202   203   226   228
SEED        000C   *18   150   152   160   162   237   238   240   241   242
SELECT      0004   *12    31    53
START       1C4F    *6    47    58
TADRS       0016   *22    37    39
TESTNO      0005   *13    30    48
TEST0       0063    22   *63
TEST1       0068    22   *73
TEST2       006D    22   *82
TEST3       007A    22   *96
TEST4       008A    22  *109
TEST5       0098    22  *126
TEST6       00BA    22  *149
TSTADR      0008   *16    43    45   127   129   132   137   155   165   180
                   181   206   208   212   214   215   218   227   229
TSTBYT      0006   *14    85    99   112   113   164   177   179
T2A         006F   *83    87
T2B         0079    84   *88
T3A         007C   *97   102
T3B         0089    98  *104
T4A         008C  *110   114
T4B         0097   111  *115
T5A         009B  *127   141
T5B         00A6  *133   138
T5C         00B4   134  *140
T6A         00C3  *154   157
T6B         00D6  *163   168
T6C         00E4   166  *169
```

**Program Follows**

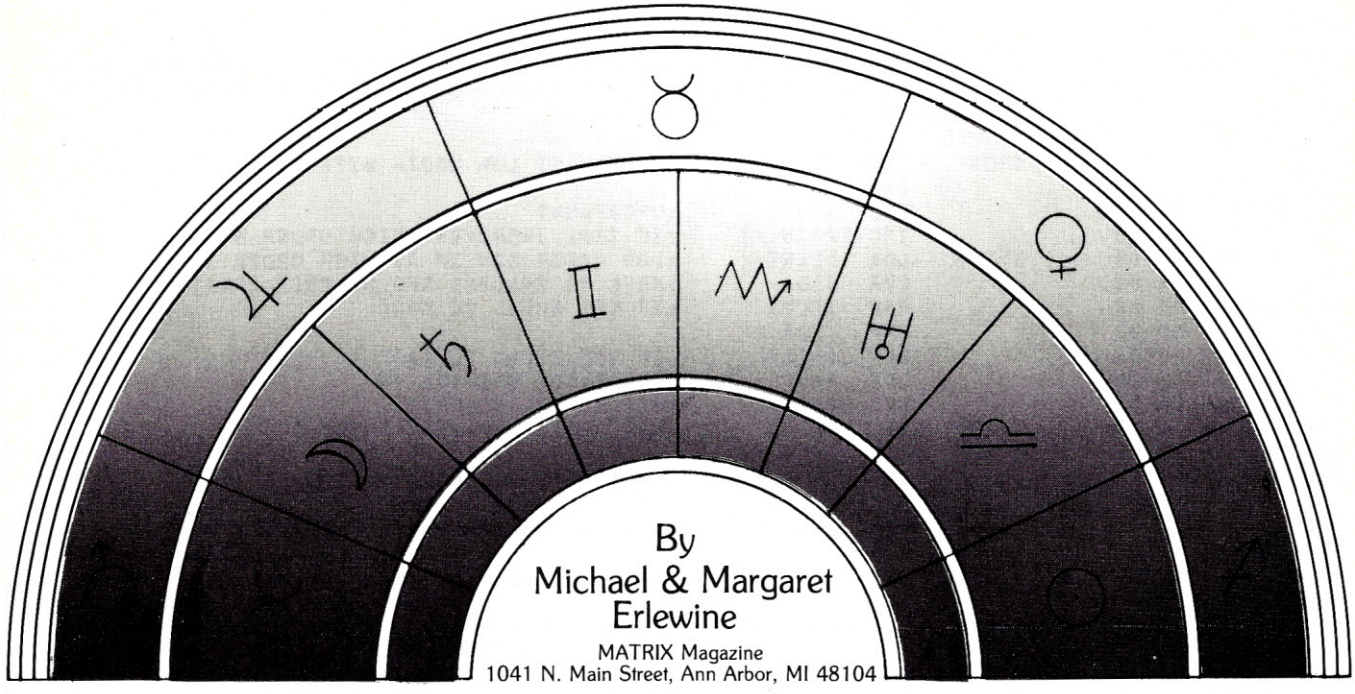
## Program Listing

```
 1                              *=0
 2
 3
 4  00FA                POINTL=$FA       ;KIM DISPLAY ADDRESS (LOW)
 5  00FB                POINTH=$FB       ;KIM DISPLAY ADDRESS (HIGH)
 6  1C4F                START=$1C4F      ;KIM DISPLAY ENTRY POINT
 7  003D                JSRADR=$3D       ;TEST SUBROUTINE CALLING POINT
 8
 9
10  0000  00 00         SADR     .WORD 0 ;TEST AREA STARTING ADDRESS
11  0002  00 00         EADR     .WORD 0 ;TEST AREA ENDING ADDRESS
12  0004  00            SELECT   .BYTE 0 ;TEST SELECTION BYTE
13  0005  00            TESTNO   .BYTE 0 ;NUMBER OF TEST BEING EXECUTED
14  0006  00            TSTBYT   .BYTE 0 ;CORRECT DATA BYTE
15  0007  00            LOOPCT   .BYTE 0 ;NUMBER OOF COMPLETE ITERATIONS THROUGH SELECTED TESTS
16  0008  00 00         TSTADR   .WORD 0 ;ADDRESS OF BYTE UNDER TEST
17  000A  00 00         POINT    .WORD 0 ;ADDRESS OF INTERFERING BYTE FOR TEST5
18  000C  17 D9         SEED     .DBYTE $17D9    ;INITIAL RANDOM NUMBER
19  000E  01 02 04      MASKS    .BYTE 1,2,4,8,$10,$20,$40,$80   ;TEST SELECT MASKS
20  0011  08 10 20
21  0014  40 80
22  0016  63 00 68      TADRS    .WORD TEST0,TEST1,TEST2,TEST3,TEST4,TEST5,TEST6 ;TEST ADDRESSES
23  0019  00 6D 00
24  001C  7A 00 8A
25  001F  00 98 00
26  0022  BA 00
27  0024  A9 00                  LDA  #0          ;INIT LOOP COUNTER
28  0026  85 07                  STA  LOOPCT
29  0028  A2 00         BEGIN    LDX  #0          ;START CHECKING AT TEST0
30  002A  86 05         MAIN     STX  TESTNO      ;SAVE TEST NUMBER
31  002C  A5 04                  LDA  SELECT      ;GET TEST SELECT BYTE
32  002E  35 0E                  AND  MASKS,X     ;MASK SELECT BYTE
33  0030  F0 1B                  BEQ  INCRS       ;IF NOT
34  0032  8A                     TXA              ;DOUBLE INDEX FOR ADDRESS TABLE
35  0033  0A                     ASL  A
36  0034  AA                     TAX
37  0035  B5 16                  LDA  TADRS,X     ;GET LOW BYTE OF TEST ADDRESS
38  0037  85 3E                  STA  JSRADR+1    ;STORE IT IN SUBROUTINE CALL
39  0039  B5 17                  LDA  TADRS+1,X   ;GET HIGH BYTE OF TEST ADDRESS
40  003B  85 3F                  STA  JSRADR+2    ;STORE IT IN SUBROUTINE CALL
41  003D  20 3D 00               JSR  *           ;ADDRESS OF TEST FILLED IN ABOVE
42  0040  F0 0B                  BEQ  INCRS       ;IF NO ERROR
43  0042  A5 08                  LDA  TSTADR      ;LOW ADDRESS OF ERROR BYTE
44  0044  85 FA                  STA  POINTL      ;KIM DISPLAY LOCATION
45  0046  A5 09                  LDA  TSTADR+1    ;HIGH ADDRESS
46  0048  85 FB                  STA  POINTH      ;KIM DISPLAY LOCATION
47  004A  4C 4F 1C               JMP  START       ;GO TO KIM DISPLAY ROUTINE
48  004D  A6 05         INCRS    LDX  TESTNO      ;INCREMENT TEST NUMBER
49  004F  E8                     INX
50  0050  E0 07                  CPX  #7          ;ALL TESTS RUN?
51  0052  D0 D6                  BNE  MAIN        ;IF NOT
52  0054  E6 07                  INC  LOOPCT      ;INCREMENT LOOP COUNT
53  0056  A5 04                  LDA  SELECT      ;WAS INDEFINITE REPEAT SELECTED?
54  0058  30 CE                  BMI  BEGIN       ;IF YES
55  005A  A9 00                  LDA  #0          ;GOOD RETURN TO KIM
56  005C  85 FA                  STA  POINTL      ;SET UP DISPLAY OF 0
57  005E  85 FB                  STA  POINTH
58  0060  4C 4F 1C               JMP  START       ;GO TO KIM DISPLAY ADDRESS
59                      ;  TEST0 WRITES A BYTE OF ALL ZEROES IN EACH TEST LOCATION, CHECKING
60                      ;  AFTER EACH WRITE.  A FAILURE INDICATES THAT ONE OR MORE BITS ARE
61                      ;  HUNG HIGH.
62
```

```
 63  0063  A9 00      TEST0   LDA  #0          ;SET FIXED PATTERN
 64  0065  4C 00 01           JMP  FPRTN       ;CALL FIXED PATTERN TEST ROUTINE
 65
 66
 67
 68
 69                   ;  TEST1 WRITES A BYTE OF ALL ONES IN EACH TEST LOCATION, CHECKING
 70                   ;  AFTER EACH WRITE.  A FAILURE INDICATES THAT ONE OR MORE BITS ARE
 71                   ;  HUNG LOW.
 72
 73  0068  A9 FF      TEST1   LDA  #$FF        ;SET FIXED PATTERN
 74  006A  4C 00 01           JMP  FPRTN       ;CALL FIXED PATTERN TEST ROUTINE
 75
 76
 77
 78
 79                   ;  TEST2 SLIDES A ONE FROM RIGHT TO LEFT THROUGH EVERY MEMORY LOCATION.
 80                   ;  IT WILL DETECT ADJACENT BITS TIED TOGETHER.
 81
 82  006D  A9 01      TEST2   LDA  #1          ;INITIALIZE PATTERN
 83  006F  20 00 01   T2A     JSR  FPRTN       ;CALL FIXED PATTERN TEST ROUTINE
 84  0072  D0 05              BNE  T2B         ;EXIT IF ERROR
 85  0074  A5 06              LDA  TSTBYT
 86  0076  0A                 ASL  A           ;SHIFT PATTERN
 87  0077  D0 F6              BNE  T2A         ;IF NOT FINISHED
 88  0079  60        T2B      RTS
 89
 90
 91
 92
 93                   ;  TEST3 SLIDES A ZERO FROM RIGHT TO LEFT THROUGH EVERY MEMORY LOCATION
 94                   ;  IT WILL DETECT ADJACENT OR NON-ADJACENT BITS TIED TOGETHER.
 95
 96  007A  A9 FE      TEST3   LDA  #$FE        ;INITIALIZE PATTERN
 97  007C  20 00 01   T3A     JSR  FPRTN       ;CALL FIXED PATTERN TEST ROUTINE
 98  007F  D0 08              BNE  T3B         ;EXIT IF ERROR
 99  0081  A5 06              LDA  TSTBYT
100  0083  38                 SEC              ;ROTATE PATTERN
101  0084  2A                 ROL  A
102  0085  B0 F5              BCS  T3A         ;IF NOT FINISHED
103  0087  A9 00              LDA  #0          ;ZERO FOR OK RETURN
104  0089  60        T3B      RTS
105                  ;  TEST4 WRITES A BYTE OF ZEROES IN EACH TEST LOCATION, CHECKING
106                  ;  AFTER EACH WRITE.  THE PATTERN IS THEN INCREMENTED AND THE
107                  ;  TEST REPEATED UNTIL ALL PATTERNS HAVE BEEN CHECKED.
108
109  008A  A9 00      TEST4   LDA  #0          ;INITIALIZE PATTERN
110  008C  20 00 01   T4A     JSR  FPRTN       ;CALL FIXED PATTERN TEST ROUTINE
111  008F  D0 06              BNE  T4B         ;EXIT IF ERROR
112  0091  E6 06              INC  TSTBYT      ;INCREMENT PATTERN
113  0093  A5 06              LDA  TSTBYT      ;HAVE WE DONE ALL PATTERNS YET?
114  0095  D0 F5              BNE  T4A         ;IF NOT
115  0097  60        T4B      RTS
116
117
118
119
120                  ;  TEST5 PERFORMS A COMPLETE ADDRESS TEST OF THE SELECTED MEMORY AREA.
121                  ;  IT WRITES A BYTE OF ZEROES IN THE FIRST BYTE, THEN ALL ONES IN THE
122                  ;  REST OF THE TEST AREA, CHECKING FOR INTERFERENCE.  IT THEN
123                  ;  INCREMENTS THE ADDRESS AND REPEATS THE TEST UNTIL ALL POSSIBLE BYTES
124                  ;  HAVE BEEN CHECKED FOR ADDRESSING PROBLEMS.
```

```
125
126  0098  20 44 01   TEST5   JSR  INITAD      ;INITIALIZE TSTADR
127  009B  A5 08       T5A     LDA  TSTADR      ;SET POINT TO INITIAL ADDRESS
128  009D  85 0A              STA  POINT
129  009F  A5 09              LDA  TSTADR+1
130  00A1  85 0B              STA  POINT+1
131  00A3  98                 TYA               ;SET PATTERN TO ZERO
132  00A4  91 08              STA  (TSTADR),Y   ;CLEAR THE BYTE UNDER TEST
133  00A6  20 13 01   T5B     JSR  INCR         ;INCREMENT POINT & TEST FOR DONE
134  00A9  F0 09              BEQ  T5C          ;IF DONE
135  00AB  A9 FF              LDA  #$FF         ;SET PATTERN TO ALL ONES
136  00AD  91 0A              STA  (POINT),Y    ;STORE IN MEMORY
137  00AF  B1 08              LDA  (TSTADR),Y   ;CHECK FOR INTERFERENCE WITH TEST BYTE
138  00B1  F0 F3              BEQ  T5B          ;NO INTERFERENCE, CONTINUE
139  00B3  60                 RTS     ;ERROR EXIT
140  00B4  20 33 01   T5C     JSR  INCTAD       ;INCREMENT TSTADR, CHECK FOR = EADR
141  00B7  D0 E2              BNE  T5A          ;IF NOT FINISHED
142  00B9  60                 RTS               ;GOOD RETURN
143                    ;  TEST6 STORES A PSEUDO-RANDOM PATTERN IN THE ENTIRE TEST AREA.  IT
144                    ;  THEN CHECKS EVERY BYTE FOR CORRECTNESS.  THIS TEST WILL FAIL IF ANY
145                    ;  ADDRESSING ERRORS OCCUR, AS WELL AS FOR OCCURENCES OF DATA ERRORS
146                    ;  OR PATTERN SENSITIVITY.
147
148
149  00BA  20 44 01   TEST6   JSR  INITAD       ;INITIALIZE TSTADR
150  00BD  A5 0C              LDA  SEED         ;SAVE RANDOM NUMBER SEED ON STACK
151  00BF  48                 PHA
152  00C0  A5 0D              LDA  SEED+1
153  00C2  48                 PHA
154  00C3  20 4E 01   T6A     JSR  RAND         ;GET RANDOM NUMBER
155  00C6  91 08              STA  (TSTADR),Y   ;STORE BYTE IN TEST AREA
156  00C8  20 33 01           JSR  INCTAD       ;INCREMENT TSTADR, CHECK FOR = EADR
157  00CB  D0 F6              BNE  T6A          ;IF NOT FINISHED
158  00CD  20 44 01           JSR  INITAD       ;RE-INITIALIZE POINT
159  00D0  68                 PLA               ;RESTORE RANDOM NUMBER SEED FROM STACK
160  00D1  85 0D              STA  SEED+1
161  00D3  68                 PLA
162  00D4  85 0C              STA  SEED
163  00D6  20 4E 01   T6B     JSR  RAND         ;GET RANDOM NUMBER
164  00D9  85 06              STA  TSTBYT       ;SAVE IN DATA LOCATION
165  00DB  D1 08              CMP  (TSTADR),Y   ;CHECK LOCATION FOR CORRECT DATA
166  00DD  D0 05              BNE  T6C          ;IF ERROR
167  00DF  20 33 01           JSR  INCTAD       ;INCREMENT TSTADR, CHECK FOR = EADR
168  00E2  D0 F2              BNE  T6B          ;IF NOT FINISHED
169  00E4  60         T6C     RTS
170                           *=$100
171
172
173
174                    ;  FPRTN WRITES THE PATTERN IN THE ACCUMULATOR
175                    ;  IN EACH LOCATION IN THE TEST RANGE.
176
177  0100  85 06      FPRTN   STA  TSTBYT       ;SAVE TEST PATTERN
178  0102  20 44 01           JSR  INITAD       ;INITIALIZE TSTADR
179  0105  A5 06      FPRTN1  LDA  TSTBYT
180  0107  91 08              STA  (TSTADR),Y   ;STORE IN NEXT MEMORY LOCATION
181  0109  D1 08              CMP  (TSTADR),Y   ;COMPARE TO TEST PATTERN
182  010B  D0 05              BNE  FPRTN2       ;IF ERROR
183  010D  20 33 01           JSR  INCTAD       ;INCREMENT TSTADR
184  0110  D0 F3              BNE  FPRTN1       ;IF NOT DONE YET
185  0112  60         FPRTN2  RTS               ;WHEN DONE OR ERROR
186
```

```
187
188
189                     ;  INCR INCREMENTS POINT,  IF THE RESULT EQUALS EADR, THE POINTER IS
190                     ;  RE-INITIALIZED TO SADR,  THE RESULT IS COMPARED TO TSTADR AND THE
191                     ;  ROUTINE EXITS.
192
193  0113  A6 0A        INCR    LDX  POINT       ;INCREMENT LOW ORDER BYTE
194  0115  E8                    INX
195  0116  D0 02                 BNE  INCR1       ;OVERFLOW?
196  0118  E6 0B                 INC  POINT+1     ;IF YES, INCREMENT HIGH ORDER BYTE
197  011A  A5 0B        INCR1   LDA  POINT+1     ;LOW ORDER NOW IN X, HIGH ORDER IN A
198  011C  E4 02                 CPX  EADR        ;HAVE WE REACHED END OF TEST AREA?
199  011E  D0 08                 BNE  INCR2       ;IF NOT EQUAL TO EADR
200  0120  C5 03                 CMP  EADR+1
201  0122  D0 04                 BNE  INCR2       ;IF NOT EQUAL TO EADR
202  0124  A6 00                 LDX  SADR        ;IF EQUAL, PREPARE TO
203  0126  A5 01                 LDA  SADR+1      ;RE-INITIALIZE POINT
204  0128  86 0A        INCR2   STX  POINT       ;RESTORE OR RE-INITIALIZE POINT
205  012A  85 0B                 STA  POINT+1
206  012C  E4 08                 CPX  TSTADR      ;EQUAL TO TEST ADDRESS?
207  012E  D0 02                 BNE  INCR3       ;IF NOT
208  0130  C5 09                 CMP  TSTADR+1    ;THIS SETS ZERO FLAG IF POINT = TSTADR
209  0132  60           INCR3   RTS
210                     ;  INCTAD INCREMENTS TSTADR AND COMPARES RESULT TO EADR
211
212  0133  E6 08        INCTAD  INC  TSTADR      ;INCREMENT LOW ORDER TSTADR
213  0135  D0 02                 BNE  INCTA1      ;IF NO OVERFLOW
214  0137  E6 09                 INC TSTADR+1     ;INCREMENT HIGH ORDER TSTADR
215  0139  A5 08        INCTA1  LDA  TSTADR      ;COMPARE TSTADR TO EADR
216  013B  C5 02                 CMP  EADR
217  013D  D0 04                 BNE  INCTA2      ;IF LOW ORDER NOT EQUAL
218  013F  A5 09                 LDA  TSTADR+1    ;CHECK HIGH ORDER BYTE
219  0141  C5 03                 CMP  EADR+1      ;SET ZERO IF TSTADR = EADR
220  0143  60           INCTA2  RTS
221
222
223                     ;  INITAD INITIALIZES TSTADR TO SADR
224
225  0144  A0 00        INITAD  LDY  #0          ;INITIALIZE OFFSET
226  0146  A5 00                 LDA  SADR        ;LOW ORDER STARTING ADDRESS
227  0148  85 08                 STA  TSTADR      ;TO TSTADR
228  014A  A5 01                 LDA  SADR+1      ;HIGH ORDER STARTING ADDRESS
229  014C  85 09                 STA  TSTADR+1    ;TO TSTADR + 1
230
231
232                     ;  RAND FORMS A SINGLE-BYTE RANDOM NUMBER IN THE A-REGISTER FROM
233                     ;  A 16-BIT NUMBER IN SEED.  THE NUMBER IS FORMED BY SHIFTING SEED ONE
234                     ;  BIT TO THE LEFT AND INSERTING THE SINGLE-BIT EXCLUSIVE-OR OF THE
235                     ;  HIGH ORDER BIT OF EACH BYTE OF SEED INTO THE RIGHT-MOST POSITION OF
236                                                                                  SEED.
237  014E  A5 0C        RAND    LDA  SEED        ;PERTUBATE RANDOM NUMBER SEED
238  0150  45 0D                 EOR  SEED+1      ;FORM EXCLUSIVE-OR
239  0152  2A                    ROL  A           ;PUT EXCLUSIVE-OR OF HIGH ORDER BITS IN CARRY
240  0153  26 0C                 ROL  SEED        ;ROTATE HIGH ORDER BYTE OF PATTERN
241  0155  26 0D                 ROL  SEED+1      ;ROTATE HIGH ORDER BYTE OF PATTERN
242  0157  A5 0C                 LDA  SEED        ;GET LOW ORDER BYTE AS TEST DATA
243  0159  60                    RTS
244
245
246                         .END
```



By
Michael & Margaret
Erlewine
MATRIX Magazine
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# Astrological Horoscope Program

What's your Rising Sign? Have you any planets in the Fifth House? What Sign was the Moon in at your birth? The following program can give answers to these questions and more; it can allow you to set-up a complete natal horoscope for any birth or event desired.

The validity of Astrology or its usefulness may be a somewhat controversial issue, but there is nothing controversial or "fuzzy" about the computations necessary to obtain accurate planet positions for any moment in time. This program is one of many currently under development by a small group of individuals interested in implementing the methods of astro-dynamics on small systems and even hand programmable calculators. A group of around 100 readers, some astrologers. . .some not, communicates and shares programs and news through Matrix magazine.

To our knowledge, the present program is the most accurate planetary program ever implemented on a small machine. The program runs (without remarks) in a little over 6K and could be further optimized. What is perhaps unique to this particular program is the high degree of accuracy achieved for the positions of the outer planets (Jupiter through Pluto), which in most cases are good to within several minutes of arc.

This is the result of an on-going project by astro-computer James Neely of California, who is engaged in refining the mean orbital elements for the outer planets (for the 20th century) to obtain a degree of accuracy previously possibly only on much larger machines. When this project is completed, outer planet positions may well be possible to within several seconds of arc as opposed to the 30 to 45 minutes of arc that has been the case. What this means for astro-comptuers is that very accurate planetary programs will be available for machines with as little as 8K or even 4K of user workspace. These same programs will run on the more sophisticated programmable hand calculators.

## USER INSTRUCTIONS: DATA NEEDED FOR INPUT

The only input needed for this program is the standard birth information: month, day, year and time of birth along with the place and the Standard Time Zone. For those who are not sure as to the time-of-day of their birth, birth certificates or parents' memories can be checked. As a last resort: write the Department of Vital Records at your state capitol.

The Geographic Longitude and Latitude for the city or place of your birth will be listed along the margin of any road atlas and are available, in more precise form, in the back pages of the *Times Atlas: Comprehensive Edition* at your local library. The only piece of information needed is the Standard Time Zone (in hours) used in that part of the country where you were born. (Eastern Standard Time = 5 hours, Central Standard Time = 6 hours, Mountain Standard Time = 7 hours and Pacific Standard Time = 8 hours).

The program makes use of a method of data entry congenial to those terminals that have a separate number keypad. The decimal point "." is used rather than the comma for Input. This allows fast and efficient entry of data (note: for those without the separate number keypad, the decimal point is right next to the comma).

Heart Center School of Astrology DAYS OF THE YEAR

| JAN. | FEB. | MAR. | APR. | MAY | JUNE | JULY | AUG. | SEPT. | OCT. | NOV. | DEC. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 366 | 32 397 | 60 425 | 091 456 | 121 486 | 152 517 | 182 547 | 213 578 | 244 609 | 274 639 | 305 670 | 335 700 | 01 |
| 02 367 | 33 398 | 61 426 | 092 457 | 122 487 | 153 518 | 183 548 | 214 579 | 245 610 | 275 640 | 306 671 | 336 701 | 02 |
| 03 368 | 34 399 | 62 427 | 093 458 | 123 488 | 154 519 | 184 549 | 215 580 | 246 611 | 276 641 | 307 672 | 337 702 | 03 |
| 04 369 | 35 400 | 63 428 | 094 459 | 124 489 | 155 520 | 185 550 | 216 581 | 247 612 | 277 642 | 308 673 | 338 703 | 04 |
| 05 370 | 36 401 | 64 429 | 095 460 | 125 490 | 156 521 | 186 551 | 217 582 | 248 613 | 278 643 | 309 674 | 339 704 | 05 |
| 06 371 | 37 402 | 65 430 | 096 461 | 126 491 | 157 522 | 187 552 | 218 583 | 249 614 | 279 644 | 310 675 | 340 705 | 06 |
| 07 372 | 38 403 | 66 431 | 097 462 | 127 492 | 158 523 | 188 553 | 219 584 | 250 615 | 280 645 | 311 676 | 341 706 | 07 |
| 08 373 | 39 404 | 67 432 | 098 463 | 128 493 | 159 524 | 189 554 | 220 585 | 251 616 | 281 646 | 312 677 | 342 707 | 08 |
| 09 374 | 40 405 | 68 433 | 099 464 | 129 494 | 160 525 | 190 555 | 221 586 | 252 617 | 282 647 | 313 678 | 343 708 | 09 |
| 10 375 | 41 406 | 69 434 | 100 465 | 130 495 | 161 526 | 191 556 | 222 587 | 253 618 | 283 648 | 314 679 | 344 709 | 10 |
| 11 376 | 42 407 | 70 435 | 101 466 | 131 496 | 162 527 | 192 557 | 223 588 | 254 619 | 284 649 | 315 680 | 345 710 | 11 |
| 12 377 | 43 408 | 71 436 | 102 467 | 132 497 | 163 528 | 193 558 | 224 589 | 255 620 | 285 650 | 316 681 | 346 711 | 12 |
| 13 378 | 44 409 | 72 437 | 103 468 | 133 498 | 164 529 | 194 559 | 225 590 | 256 621 | 286 651 | 317 682 | 347 712 | 13 |
| 14 379 | 45 410 | 73 438 | 104 469 | 134 499 | 165 530 | 195 560 | 226 591 | 257 622 | 287 652 | 318 683 | 348 713 | 14 |
| 15 380 | 46 411 | 74 439 | 105 470 | 135 500 | 166 531 | 196 561 | 227 592 | 258 623 | 288 653 | 319 684 | 349 714 | 15 |
| 16 381 | 47 412 | 75 440 | 106 471 | 136 501 | 167 532 | 197 562 | 228 593 | 259 624 | 289 654 | 320 685 | 350 715 | 16 |
| 17 382 | 48 413 | 76 441 | 107 472 | 137 502 | 168 533 | 198 563 | 229 594 | 260 625 | 290 655 | 321 686 | 351 716 | 17 |
| 18 383 | 49 414 | 77 442 | 108 473 | 138 503 | 169 534 | 199 564 | 230 595 | 261 626 | 291 656 | 322 687 | 352 717 | 18 |
| 19 384 | 50 415 | 78 443 | 109 474 | 139 504 | 170 535 | 200 565 | 231 596 | 262 627 | 292 657 | 323 688 | 353 718 | 19 |
| 20 385 | 51 416 | 79 444 | 110 475 | 140 505 | 171 536 | 201 566 | 232 597 | 263 628 | 293 658 | 324 689 | 354 719 | 20 |
| 21 386 | 52 417 | 80 445 | 111 476 | 141 506 | 172 537 | 202 567 | 233 598 | 264 629 | 294 659 | 325 690 | 355 720 | 21 |
| 22 387 | 53 418 | 81 446 | 112 477 | 142 507 | 173 538 | 203 568 | 234 599 | 265 630 | 295 660 | 326 691 | 356 721 | 22 |
| 23 388 | 54 419 | 82 447 | 113 478 | 143 508 | 174 539 | 204 569 | 235 600 | 266 631 | 296 661 | 327 692 | 357 722 | 23 |
| 24 389 | 55 420 | 83 448 | 114 479 | 144 509 | 175 540 | 205 570 | 236 601 | 267 632 | 297 662 | 328 693 | 358 723 | 24 |
| 25 390 | 56 421 | 84 449 | 115 480 | 145 510 | 176 541 | 206 571 | 237 602 | 268 633 | 298 663 | 329 694 | 359 724 | 25 |
| 26 391 | 57 422 | 85 450 | 116 481 | 146 511 | 177 542 | 207 572 | 238 603 | 269 634 | 299 664 | 330 695 | 360 725 | 26 |
| 27 392 | 58 423 | 86 451 | 117 482 | 147 512 | 178 543 | 208 573 | 239 604 | 270 635 | 300 665 | 331 696 | 361 726 | 27 |
| 28 393 | 59 424 | 87 452 | 118 483 | 148 513 | 179 544 | 209 574 | 240 605 | 271 636 | 301 666 | 332 697 | 362 727 | 28 |
| 29 394 | | 88 453 | 119 484 | 149 514 | 180 545 | 210 575 | 241 606 | 272 637 | 302 667 | 333 698 | 363 728 | 29 |
| 30 395 | | 89 454 | 120 485 | 150 515 | 181 546 | 211 576 | 242 607 | 273 638 | 303 668 | 334 699 | 364 729 | 30 |
| 31 396 | | 90 455 | | 151 516 | | 212 577 | 243 608 | | 304 669 | | 365 730 | 31 |

Numbers in the FIRST COLUMN for each month are NUMBER OF DAYS from January 1 considered as NUMBER ONE. Numbers in the SECOND COLUMN for each month are simply the number in the first column INCREASED by 365 (one year) for easy subtraction between two dates. *PLEASE NOTE:* For LEAP YEARS ADD one day after February 29 to listed DAY NUMBER.
*TO EXPRESS ANY DAY OF THE YEAR AS DECIMAL FRACTION OF A YEAR:* Simply DIVIDE number by 365. For example: July 18,1941 to YEAR and DECIMAL FRACTION = Number for July 18 (from TABLE) is 199 ÷ 365 = .545205 + 1941 = 1941.545205. [to CONVERT fraction into DAY NUMBER, simply multiply by 365. Example: .545205 X 365 = 199th day of year or July 18] TABLE 5

**Figure 1**

This program was written on the new Commodore PET 2001 (8K version). The special PET graphics and format instructions have been deleted so that the program, as listed, should run on any BASIC that has trig functions (Extended BASICs are perfect).

The program OUTPUTS the planetary positions in the Zodiac as well as all 12 of the House Cusps (including the Rising Sign). We hope you enjoy this program. Here is an opportunity to check out the conditions of the Cosmos as your birth moment. . .or to see what is happening at this very moment, plug in today's date.

## ADDITIONAL NOTES

ZODIAC: The Zodiac is a circle of 360 degrees that has been divided into the 12 Signs of the Zodiac (30 degrees for each Sign). The positions for the planets and house cusps are given in three parts. For example, if your Sun is at 17 CAP 33, it reads as follows: Seventeen degrees and thirty-three minutes of the Sign Capricorn. The following abbreviations have been used:

ARI = ARIES
TAU = TAURUS
GEM = GEMINI
CAN = CANCER
LEO = LEO
VIR = VIRGO
LIB = LIBRA
SCO = SCORPIO
SAG = SAGITTARIUS
CAP = CAPRICORN
AQU = AQUARIUS
PIS = PISCES

RETROGRADE: A planet listing followed by the letter "R" indicates that the planet was moving in a retrograde or backward motion through the Zodiac at that moment.

DATE INPUT: The program is designed to operate for any date in the 20th century, but will accept input for any month, day and year from 0 A.D. on. The Julian Day Number routine was authored by Richard C. Singleton and dates prior to October 15, 1582 are assumed to be in the Julian Calendar.

PRECISION: For best results this program should be run on a BASIC with a precision of 9 digits or better.

EASTERN LONGITUDES, SOUTHERN LATITUDES: The program will work as well for East Longitudes (East of Greenwich, England) and Southern Geographic Latitudes, but the data for these cases must be preceded by a minus "−" sign. For example, to erect a chart for Brisbane, Australia with a Geographic Longitude of 153 °E 01′ and Latitude of 27 °S 28′ and a Time Zone of 10 hours East, input entries would be as follows:

- TIME ZONE (IN HOURS)? −10
- GEOGRAPHIC LONGITUDE: DD.MM? −153.01
- GEOGRAPHIC LATITUDE: DD.MM? −27.28

HOUSE SYSTEM USED: Astrologers use a variety of house systems. This program makes use of the Koch (GOH) House System and the routine used here was authored by Robert Hand. In the sample chart, you will notice that the Zodiac Signs Aries and Libra don't appear as house cusps. This is what is known as "Intercepted Signs" and are to be expected from time to time.

Special thanks to Newman Computer Exchange for getting our new PET to list so readers could have this program.□

**Program Follows**

## Program Listing

```
 10 REM TITLE: ASTROLOGICAL HOROSCOPE
 12 REM PROGRAMMED BY: MICHAEL ERLEWINE
 14 REM                1041 N. MAIN ST.
 16 REM (313) 663-6677 ANN ARBOR, MI 48104
 18 REM PERMISSION TO USE, BUT NOT TO SELL
 20 REM   COPYRIGHT © 1978 BY M. ERLEWINE
 22 REM
100 DIMK(12):DIMHC(12):DIMC$(12):DIMHC$(12):DIMZ$(12)
109 REM CONVERTS DD.MMSS TO DD/DECIMAL FRACTION
110 DEF FNQ(X)=INT(X)+INT((X-INT(X))*100+.5)/60
119 REM SINE FUNCTION WHEN WORKING IN DEGREES
120 DEF FNS(X)=SIN(X*PI/180)
125 PI=3.141592654
129 REM DEFINED FUNCTION THAT CASTS OUT UNITIES/CIRCLES
130 DEF FNU(X)=X-(INT(X/360)*360)
139 REM ROUNDING ROUTINE TO TWO PLACES
140 DEF FNW(X)=INT(X*100+.5)/100
149 REM CONVERTS SECONDS TO DEGREES,HANDLES SIGNED NUMBERS & UNITIES
150 DEF FNP(X)=SGN(X)*((ABS(X)/3600)/360-INT((ABS(X)/3600)/360))*360
159 REM CONVERTS DEGREES TO RADIANS/ RADIANS TO DEGREES
160 DEF FNR(X)=X*PI/180: DEF FND(X)=X*180/PI
169 REM ARCSINE ROUTINE
170 DEF FNX(X)=ATN(X/(1-X*X)+.5)
200 FOR I=1 TO 12: READ C$(I), Z$(I), HC$(I): NEXT I
210 INPUT"*BIRTHDATE: MM.DDYYYY="; A$
211 REM BREAK A$ INTO MONTH, DAY & YEAR
212 M=VAL(MID$(A$,1,2))
214 D=VAL(MID$(A$,4,2))
216 Y=VAL(MID$(A$,6,4))
220 INPUT"*IS BIRTH AM OR PM"; F$
230 INPUT"*TIME HH.MM"; F
240 INPUT"*TIME ZONE (IN HOURS)"; X
250 F=(FNQ(F)+X)/24
252 IF F$="PM" THEN F=F+.5
260 INPUT"*GEOGRAPHIC LONGITUDE: DD.MM"; L
262 L5=SGN(L)*FNQ(ABS(L))
270 INPUT"*GEOGRAPHIC LATITUDE: DD.MM"; B4
272 B4=FNR(SGN(B4)*FNQ(ABS(B4)))
279 REM JULIAN DAY NUMBER ROUTINE
280 IM=12*(Y+4800)+M-3
282 J=(2*(IM-INT(IM/12)*12)+7+365*IM)/12
284 J=INT(J)+D+INT(IM/48)-32083
286 IF J<=2299171 GOTO 290
288 J=J+INT(IM/4800)-INT(IM/1200)+38
289 REM TIME INTERVAL FROM 1900.0 IN JULIAN CENTURIES
290 T=(((J-2415020)+F)-.5)/36525
299 REM GREENWICH SIDEREAL TIME ROUTINE
300 RG=(23925.836+8640184.542*T+.0929*T*T)/3600
302 RG=(RG+F*24)/24
309 REM RAMC ROUTINE (LOCAL SIDEREAL TIME)
310 RA=FNU(((RG-INT(RG))*24)*15-L5)
315 RA=FNR(RA)
319 REM  OBLIQUITY OF THE ECLIPTIC FOR EPOCH
320 OB=FNR(23.45229444-.0130125*T)
650 ML=ML-109.8*FNS(L+L1)-55.2*FNS(2*F-X)-45.1*FNS(L+2*F)+39.5*FNS(L-2*F)
655 ML=ML-38.4*FNS(L-4*D)+36.1*FNS(3*L)-30.8*FNS(2*L-4*D)-28.5*FNS(L-L1-2*D)
660 C(1)=FNP(LL+ML): C(2)=FNU(FNP(NN))
665 FOR I=1 TO 2
670 Z=C(I):GOSUB 920:PRINT TAB(10);Z1;TAB(14);Z$(Q);Z2;TAB(21);C$(I+9)
675 NEXT I
690 PRINT:PRINT"PRESS ANY KEY FOR NEW CHART"
700 GET G$: IF G$="" GOTO 700
710 RUN 100
720 END
898 REM SUBROUTINES FOLLOW
899 REM ASSEMBLES ORBITAL ELEMENTS FOR EPOCH
900 READ S,S1,S2: S=S+S1*T+S2*T*T: RETURN
919 REM TRANSFORM DEGREES/DECIMAL TO ZODIAC DEGREES/SIGN/MINUTES FORMAT
920 Z3=INT(Z):Q=INT(Z3/30)+1:Z1=INT(FNW((Z3/30-INT(Z3/30))*30))
925 Z2=INT(INT(((Z-Z3)*60)*10+.5)/10):RETURN
929 REM POLAR TO RECTANGULAR COORDINATES
930 IF A=Ø THEN A=1.74533E-09
931 X=R*COS(A): Y=R*SIN(A): RETURN
949 REM RECTANGULAR TO POLAR COORDINATES
950 IF Y=Ø THEN Y=1.74533E-09
951 R=(X*X+Y*Y)+.5: A=ATN(Y/X): IF A < Ø THEN A=A+PI
952 IF Y < Ø THEN A=A+PI
954 RETURN
959 REM (KOCH) HOUSE ROUTINE AUTHORED BY ROBERT HAND
960 AD=FNX(SIN(RA)*TAN(ABS(OB))*TAN(B4))
965 OA=RA-AD:SA=PI/2+AD: AX=SA/3: HC(1)=MC
970 FOR I=1 TO 5
975 KO=FNR(FNU(FND(OA+AX*I)))
980 AA=ATN(TAN(B4)/COS(KO))
985 AB=AA+ABS(OB): LO=ATN(TAN(KO)*COS(AA)/COS(AB))
990 IF LO < Ø THEN LO=LO+PI
995 IF SIN(KO)<Ø THEN LO=LO+PI
1000 HC(I+1)=FND(LO)
1010 NEXT I
1020 FOR I=1 TO 6: Z=FNU(HC(I)): GOSUB 920
1030 PRINT"THE ";HC$(I);" HOUSE CUSP =";Z1;TAB(25);Z$(Q);Z2
1035 NEXT I
1040 FOR I=1 TO 6
1045 Z=FNU(HC(I)+180): GOSUB 920
1050 PRINT"THE ";HC$(I+6);" HOUSE CUSP =";Z1;TAB(25);Z$(Q);Z2
1055 NEXT I
1060 RETURN
1999 REM DATA ARE SEPARATED FOR READING EASE
2000 DATA SUN, ARI, "10TH", MERCURY, TAU, "11TH", VENUS, GEM, "12TH",
       MARS, CAN, " 1ST"
2001 DATA JUPITER, LEO, " 2ND", SATURN, VIR, " 3RD"
2002 DATA URANUS, LIB, " 4TH", NEPTUNE, SCO, " 5TH"
2004 DATA PLUTO, SAG, " 6TH", MOON, CAP, " 7TH", M-NODE, AQU, " 8TH",
       Ø, PIS, " 9TH"
2005 REM PLANETARY ELEMENTS FOLLOW (YOU MUST INCLUDE ZEROS TOO "Ø")
2006 DATA 358.4758445, 35999.04975, -.000150278, .01675104, -.418E-04,
       -.126E-06
2008 DATA 1.00000023, 101.2208333, 1.719175, .000452778, Ø,Ø,Ø,Ø,Ø,Ø
2010 DATA 102.2793806, 149472.5153, .6389E-05, .205614210, .2046E-04,
       -.3E-07, .3870984
2012 DATA 28.75375278, .370280556, .000120833, 47.14594444, 1.185208333,
       .173889E-03
2014 DATA 7.002880556, .001860833, -.18333E-04, 212.6032194, 58517.80386,
       .001286056
2016 DATA .00682069, -.4774E-04, .91E-07, .7233316, 54.38418611,
       .508186111, -.001386389
2018 DATA 75.77964722, .89985, .00041, 3.393630556, .00100583,
       -.972E-06, 319.529425
2020 DATA 19139.8585, .000180806, .0933129, .92064E-04, -.77E-07,
       1.5236915, 285.4317611
```

```
329 REM MIDHEAVEN CALCULATIONS
330 A=EA:R=1:GOSUB 930:X=X*COS(OB):GOSUB 950:MC=FND(A)
340 OB=-OB : REM ASCENDANT CALCULATION
345 A=B4:R=1:GOSUB 930:Q=Y:R=X:A=RA:GOSUB 930:G=X:X=Y:Y=Q:GOSUB 950:A=A+OB
350 GOSUB 930:Q=FNX(Y):Y=X:X=G:GOSUB 950
355 IF A < Ø THEN A=A+2*PI
360 AS=FNU(FND(A)+90)
361 REM CHECK FOR SOUTHERN GEOGRAPHIC LATITUDE
362 X=FND(RA):IF B4 < Ø THEN X=FNU(X+180)
363 REM CONVERT RAMC FROM DEGREES TO S.T. IN HOURS/MINUTES/SECONDS
365 X=X/15:Y=INT(X):Z=(X-Y)*60:X=INT((Z-INT(Z))*60):Z=INT(Z)
370 ST$=STR$(Y)+"H"+STR$(Z)+"M"+STR$(X)+"S"
375 PRINT"  SIDEREAL OR STAR TIME="; ST$: Z=AS: GOSUB 920
380 PRINT"  ASCENDANT OR RISING SIGN=";Z1;Z$(Q);Z2
385 PRINT"HOUSE CUSPS": PRINT: GOSUB 960
390 PRINT:PRINT"FOR PLANETS (PRESS ANY KEY)":PRINT
395 GET G$: IF G$="" GOTO 395
399 REM BEGIN LOOP FOR NINE PLANETS
400 FOR I=1 TO 9
409 REM ELEMENTS  MEAN ANOMALY & ECCENTRICITY (IN RADIANS)
410 GOSUB 900:M=FNR(FNU(S)): GOSUB 900: E=S: EA=M
419 REM SOLVE KEPLER'S EQUATION FOR ECCENTRIC ANOMALY BY ITERATION
420 FOR A=1 TO 5: EA=M+E*SIN(EA): NEXT A
429 REM CALCULATE RADIUS VECTOR
430 READ AU: RV=FNR(AU)*(1-E*COS(EA))
439 REM CALCULATE THE TRUE ANOMALY
440 X=AU*(COS(EA)-E): Y=AU*SIN(EA)*(1-E*E)↑.5
450 GOSUB 950:GOSUB 900:A=FND(A)+S:GOSUB 900:V=FNU(A+S):M=FNR(S):B=FNR(V)
459 REM REDUCE TO ECLIPTIC
460 GOSUB 900:IN=FNR(S):A=ATN(COS(IN)*TAN(B-M)):IF A < Ø THEN A=A+PI
470 A=FND(A+M): IF ABS(V-A) > 10 THEN A=A-180
479 REM C&D (BELOW) ARE THE HELIOCENTRIC LONGITUDE & LATITUDE IN RADIANS
480 C=FNR(FNU(A)): D=ATN(SIN(C-M)*TAN(IN))
484 REM CHECK FOR RETROGRADE MOTION (CIRCULAR ORBIT ONLY)
485 IF I=1 THEN M1=RV: C1=C: GOTO 510
490 X=((RV↑.5+M1↑.5)*(M1↑.5*RV↑.5))/(RV↑1.5+M1↑1.5): X=X-COS(C1-C)
495 IF X < Ø THEN H$=" R": GOTO 510
500 H$=" "
509 REM TRANSFORM HELIO POLAR TO RECTANGULAR (X,Y,Z)
510 X=RV*COS(D)*COS(C)
520 Y=RV*COS(D)*SIN(C)
530 Z=RV*SIN(D)
539 REM TRANSFORM HELIO TO GEOCENTRIC X/Y/Z
540 IF I=1 THEN X1=X: Y1=Y: Z1=Z: GOTO 570
550 X=X-X1: Y=Y-Y1: Z=Z-Z1
559 REM TRANSFORM GEO X/Y/Z TO GEO POLAR (LONGITUDE)
560 GOSUB 950: G=A:Y=Z:X=R:GOSUB 950:C=FND(G)
570 IF I=1 THEN C=FNU(FND(C1)+180)
575 Z=C:GOSUB920:PRINT TAB(10);Z1;TAB(14);Z$(Q);Z2;TAB(21);C$(I);TAB(28);H$
580 NEXT I
599 REM MOON & MOON'S NODE ROUTINE
600 LL=973563+1732564379*T-4*T*T
605 G=1012395+6189*T+1.6*T*T
610 G1=1203586+14648523*T-37*T*T
620 NN=933060-6962911*T+7.5*T*T
625 D=1262655+1602961611*T-5*T*T
630 YY=3600:L=(LL-G1)/YY:L7=LL-D:L1=(L7-G)/YY:F=(LL-NN)/YY:D=D/YY:X=2*D
635 ML=22639.6*FNS(L)-4568.4*FNS(L-X)+2369.89*FNS(X)+769*FNS(2*L)
640 ML=ML-668.9*FNS(L1)-411.6*FNS(2*F)-211.7*FNS(2*L-X)-206.2*FNS(L+L1-2*D)
645 ML=ML+191.9*FNS(L+X)-165.4*FNS(L1-X)+147.9*FNS(L-L1)-124.8*FNS(D)
```

```
2022 DATA 1.069766667, .00013125, 48.78644167, .770991667, -.1389E-05,
       1.850333333
2024 DATA -.000675, .12611E-04, 225.4928125, 3033.687936, Ø, .04838144,
       -.155E-04, Ø
2026 DATA5.20290493, 273.3930152, 1.33834464, Ø, 99.41984827, 1.05829152, Ø
2028 DATA 1.3096585, -.00515613, Ø, 174.215296, 1223.507963, Ø,
       .05422831, -.00020495
2030 DATA Ø, 9.55251745, 338.911673, -.31667941, Ø, 112.8261394,
       .82587569, Ø
2032 DATA 2.49080547, -.00466035, Ø, 74.17574887, 427.2742717, Ø, .04681664
2034 DATA .00041875, Ø, 19.22150505, 95.68630387, 2.05082548,
       Ø, 73.52220082
2036 DATA .52415598, Ø, .77256652, .00012824, Ø, 30.1329437, 240.4551595,
       Ø, .00912805
2038 DATA -.00127185, Ø, 30.1137593, 284.168255, -21.6328615, Ø, 130.6841531
2040 DATA 1.10046492, Ø, 1.77939281, -.00975088, Ø, 229.7810007,145.1781092, Ø
2042 DATA .247973760, .00289875, Ø, 89.53903455, 113.5365761, .20863761, Ø
2044 DATA 108.94405, 1.37395444, Ø, 17.15140319, -.01611824, Ø
```

## Sample Run

```
RUN
*BIRTHDATE:MM.DDYYYY=? 01.081935
*IS BIRTH AM OR PM? PM
*TIME:HH.MM? 0.20
*TIME ZONE (IN HOURS)? 6
*GEOGRAPHIC LONGITUDE: DD.MM? 88.42
*GEOGRAPHIC LATITUDE: DD.MM? 34.16
  SIDEREAL OR STAR TIME= 19H 34M 39S
  ASCENDANT OR RISING SIGN= 5 TAU 11
HOUSE CUSPS

THE 10TH HOUSE CUSP = 21 CAP 54
THE 11TH HOUSE CUSP = 21 AQU 48
THE 12TH HOUSE CUSP = 28 PIS 17
THE  1ST HOUSE CUSP = 5  TAU 11
THE  2ND HOUSE CUSP = 5  GEM 42
THE  3RD HOUSE CUSP = 0  CAN 21
THE  4TH HOUSE CUSP = 21 CAN 48
THE  5TH HOUSE CUSP = 21 LEO 48
THE  6TH HOUSE CUSP = 28 VIR 17
THE  7TH HOUSE CUSP = 5  SCO 11
THE  8TH HOUSE CUSP = 5  SAG 42
THE  9TH HOUSE CUSP = 0  CAP 21

FOR PLANETS (PRESS ANY KEY)

          17 CAP 33 SUN
          22 CAP 50 MERCURY
          29 CAP 46 VENUS
          12 LIB 56 MARS
          18 SCO 5  JUPITER
          25 AQU 41 SATURN
          27 ARI 33 URANUS
          14 VIR 27 NEPTUNE R
          25 CAN 4  PLUTO   R
          6  PIS 46 MOON
          1  AQU 50 M-NODE

 PRESS ANY KEY FOR NEW CHART
```

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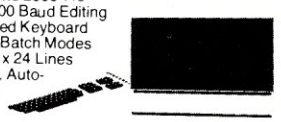
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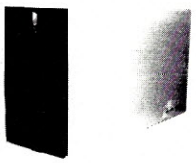
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### CASSETTE TAPES

I have used the following brand(s):
208 Ampex
209 BASF
210 Memorex
211 Pryor
212 Radio Shack
213 TDK
214 Scotch (3M)
215 Other

I buy the following number of cassette tapes in an average month:
216 1-5
217 6-10
218 Over ten

I spend the following on cassette tapes per year:
219 5-25 dollars
220 25-50 dollars
221 50-100 dollars
222 Over 100 dollars

I use a cassette tape:
223 Once only
224 Several times
(This refers to the number of times a tape will be reused)

I generally buy the following length of tape:
225 15-minute (C-15)
226 30-minute (C-30)
227 60-minute (C-60)
228 90-minute (C-90)

My favorite brand of cassette tape is:
229 Ampex
230 BASF
231 Memorex
232 Pryor
233 Radio Shack
234 TDK
235 Scotch (3M)
236 Other

My experience with cassettes has been:
237 Good
238 Bad
239 Plan to or have changed to diskettes

### FLOPPY DISKS

I have used the following brand(s)
240 Ampex
241 BASF
242 Dysan
243 Memorex
244 Pryor
245 Scotch (3M)
246 Verbatim
247 Other

I buy the following number of diskettes in an average month:
248 1-5
249 6-10
250 Over ten

I spend the following on diskettes per year:
251 1-55 dollars
252 56-100 dollars
253 101-200 dollars
254 Over 200 dollars

I use a diskette:
255 Once only
256 Several times
(This refers to the number of times a diskette will be reused)

I generally buy the following type of diskette:
257 Hard sector
258 Soft sector
259 5.25 inch
260 8 inch

My favorite brand of diskette is:
261 Ampex
262 BASF
263 Dysan
264 Memorex
265 Pryor
266 Scotch (3M)
267 Verbatim
268 Other

How long have you been involved with microcomputers?
269 One year
270 One to three years
271 Three to seven years
272 More than seven years

INTEGRATED CIRCUITS MICROPROCESSOR LED'S SOCKETS CAPACITORS DIODES TRANSISTORS RESISTORS POTENTIOMETERS

SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES

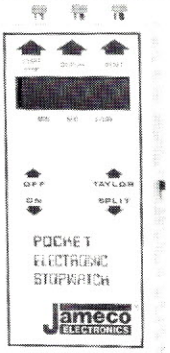
Jim-pak® electronic components

# One-Stop Component Center

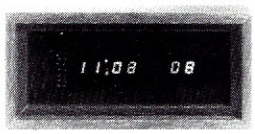
# EXCITING NEW KITS!!

## Digital Stopwatch Kit

**JE900**



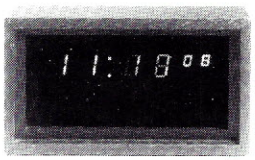

- ★ Use Intersil 7205 Chip
- ★ Plated thru double-sided P.C. Board
- ★ LED display (red)
- ★ Times to 59 min. 59.59 sec. with auto reset
- ★ Quartz crystal controlled
- ★ Three stopwatches in one: single event, split (cummulative) and taylor (sequential timing)
- ★ Uses 3 penlite batteries
- ★ Size: 4.5" x 2.15" x .90"



## JE701

- ★ Bright .300 ht. common cathode display
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 20 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"

## 6-Digit Clock Kit



## JE747

- ★ Four .630" ht. and two .300" ht. common anode displays
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 30 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"

## Jumbo 6-Digit Clock Kit

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**ALASKA**
*Anchorage* — TV Mart
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*Berkeley* — Al Lasher Electronics
*Mission Viejo* — Tower Electronics Corp.
*Monterey* — Zackit
*Oceanside* — Electronic Center
*Palo Alto* — Zack Electronics
*Pasadena* — Dow Radio Inc.
*Sacramento* — Heathkit Electronic Center
*Sacramento* — Zackit
*San Carlos* — J & H Outlet Store
*San Diego* — Radio Shack A.S.C.
*Mira Mesa*
*San Fernando* — San Fernando Electronics
*San Francisco* — Zack Electronics
*San Jose* — United Radio & TV Supply
*San Luis Obispo* — Mid-State Electronic Supply
*Santa Ana* — Quality Electronics
*Santa Cruz* — Santa Cruz Electronics
*Santa Maria* — Caps Electronics
*Santa Monica* — Mission Control
*Suisun City* — Byte Shop
*Sunnyvale* — Sunnyvale Electronics
*Vallejo* — Zackit
*Walnut Creek* — MicroSun Computer Center
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*Durango* — The Computer Shop
**CONNECTICUT**
*Bridgeport* — Bridgeport Computer
**FLORIDA**
*Ft. Lauderdale* — Computers For You
**GEORGIA**
*Atlanta* — Atlanta Computer Mart
*Columbus* — Radio Wholesale
**HAWAII**
*Honolulu* — Integrated Circuit Supply
**IDAHO**
*Idaho Falls* — Audiotronics
**ILLINOIS**
*Evanston* — Tri-State Electronic Corp.
*Groveland* — Moyer Electronics
*Mount Prospect* — Tri-State Electronic Corp.

**ILLINOIS (Continued)**
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*Rockford* — Imperial Computer Systems
*Schaumburg* — Data Domain
**INDIANA**
*East Chicago* — Acro Electronics Corp.
**IOWA**
*Indianola* — Electronix Limited
**KANSAS**
*Wichita* — Amateur Radio Equipment Company
**KENTUCKY**
*Lexington* — Radio-Electronic Equipment Co.
**LOUISIANA**
*Baton Rouge* — Pelican Electronics
*Houma* — Pelican Electronics
*Metarie* — Pelican Electronics
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*Damascus* — Damascus CB
*La Vale* — J & M Electronics
*Rockville* — Computer Workshop
*Rockville* — Heathkit Electronic Center
*Towson* — Baynesville Electronics Inc.
*Towson* — Heathkit Electronic Center
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*Clawson* — Radio Supply & Engineering
*Detroit* — Heathkit Electronic Center
*Flint* — Hobby Electronic Center
*Garden City* — Computer Center
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*Lansing* — Wedemeyer Electronic Supply
*Midland* — Computronix Corp.
*Mt. Clemens* — The Computer Store
*Niles* — Niles Radio Supply
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*Hopkins* — Heathkit Electronic Center
*St. Paul* — Heathkit Electronic Center
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**MONTANA**
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**NEBRASKA**
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*Lincoln* — Scott Electronic Supply Inc.
*Omaha* — Heathkit Electronic Center
*Omaha* — Omaha Computer Store
**NEVADA**
*Las Vegas* — Century 23
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*York* — G.Y.C. Company
**RHODE ISLAND**
*Cranston* — Jabbour Electronics City
*Pawtucket* — Jabbour Electronics City
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*Cookeville* — Wagnon's Stereo Center
*Knoxville* — Eastern Micro
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*Alexandria* — Heathkit Electronic Center
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INTEGRATED CIRCUITS MICROPROCESSOR LED'S SOCKETS CAPACITORS DIODES TRANSISTORS RESISTORS POTENTIOMETERS

SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES

CIRCLE INQUIRY NO. 28

Over the past two years customer acceptance of Vector Graphic microcomputers has just grown and grown and grown. It isn't terribly surprising, really. After all, it does make life a lot easier when you have reliable cost effective equipment.

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# BUSINESS Small Wonder




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